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THE NURSLING



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## THE FEEDING AND HYGIENE OF PREMATURE & FULL-TERM INFANTS

BY

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*Authorised Translation*

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ONE HUNDRED AND ELEVEN DIAGRAMS IN COLOUR  
AND OTHER ILLUSTRATIONS

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## TRANSLATOR'S PREFACE

EVERY summer diarrhoea relentlessly claims its toll of infant lives, and thousands of heart-broken mothers are left weeping over empty cradles. Here and there, isolated communities and individuals are nobly striving against the scourge, but the great mass of the people seem to regard it with callous indifference.

In the seventy-six great towns of England and Wales, there were during July, August, and September of this year, 14,306 deaths from diarrhoea. If a similar epidemic annually occurred among adults, the country would soon awake from its lethargy, terror would change apathy to action, and a national effort would be made to combat the plague. But, as it is only a question of infants, whose very helplessness should assert their claim upon civilised humanity, legislation halts, and philanthropy turns a deaf ear.

In this country the credit of the first organised attempt to protect infant life is due to the municipality of St. Helens, who, in 1899, opened a milk depot, modelled on Dr. Dufour's "Goutte de Lait" at Fécamp. In Battersea, Finsbury, Glasgow, Leith, Liverpool, and other towns similar institutions now exist, and their results have fully justified the large-hearted enterprise of their founders. But, why should this work be confined to the public health authorities? It is within the sphere of every medical practitioner. When he attends a woman in child-bed he has two lives confided to his care, yet his concern is almost solely for the mother, and the lying-in period being accomplished, he considers his responsibility at an end, and leaves the poor woman to her own devices in rearing her child. She is expected to have an instinctive knowledge of the science of infant-feeding: she might as well be expected to conduct her own confinement. Out of 1470

infantile deaths from diarrhœa Planchon found that 139, *i.e.* 9 per cent., occurred among breast-fed infants (see Appendix). Such a sacrifice to maternal ignorance is a reproach to the medical profession.

During ante-natal life every beat of the mother's heart brings food ready to be utilised, but from birth the mode of nutrition is completely changed, and the infant has to rely for sustenance solely upon what it, itself, ingests. What more suitable to its delicate digestive apparatus than its mother's milk, the food elaborated by nature for its use! Yet, breast-feeding is not fashionable either among rich or poor. A mother has no option but to nourish her unborn child, but, too often, alas, the moment her own free will can be exercised she denies her infant's right to look to her as the source of its food, and condemns it to the miseries and dangers of artificial feeding. Will milk secretion become a vestigial function? Are women losing their instincts of motherhood? There are some who would gladly have hirelings not only to suckle but even to bear their children. Excuses to evade nursing are legion, but the only one valid, physical incapacity, is that which is most seldom heard. If medical men would only insist upon breast-feeding, half the dangers and difficulties of rearing infants would disappear.

When recourse must be had to artificial feeding, cows' milk, sterilised and of good quality, should be used. In this country there is a great deal of prejudice against sterilised milk, for it is thought to give rise to infantile scurvy. Budin and Dufour have used it exclusively for many years, have reared innumerable infants on it, and yet they have not had a single case of this disease. I visited many other Consultations in France where sterilised milk was given, and found that in them also infantile scurvy was unknown. The milk distributed by these institutions was controlled by frequent analyses, and maintained at a uniform standard of excellence (3.7 to 3.9 per cent. of fat).

Holt<sup>1</sup> quotes the following table with reference to the occurrence of infantile scurvy.

<sup>1</sup> *Diseases of Infancy and Childhood*, p. 243, London, 1904.

*Previous Food.*

Breast milk . . . . .	12 cases, alone in 10
Raw cows' milk . . . . .	5 " " 4
Pasteurised milk . . . . .	20 " " 16
Condensed milk . . . . .	60 " " 32
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The disease may thus arise under all forms of feeding. I do not know of any recorded case of infantile scurvy arising from sterilised milk where systematic analysis showed the milk to have been consistently of good quality. It is the poverty of the milk and not its sterilisation which causes the disease. In sterilised milk alone is safety, and it must be the basis of all artificial feeding.

The importance of the quality of milk which is to serve as a food for infants need hardly be emphasised. With the object of ascertaining the average composition of the milk offered for sale throughout London, Mr. J. W. Peck, F.C.S., and I analysed 101 samples, taken at random, between September 28 and October 10, 1896 (see Appendix). 68 had been skimmed; from some 20, 25, 30, even, in one instance, 65 per cent. of the fat had been removed; 89 contained added water, some to the extent of 30 per cent.

But besides the purity and quality, the amount of the infant's daily diet must be supervised. The purest of milks, the sterile supply which flows from a mother's breast, given in excess may cause fatal digestive troubles. Each medical man ought to regulate the feeding of all infants born under his charge. His calling demands it as a duty, his humanity as a right. Every practitioner should be a centre for the protection of infant life. Whether his sphere be large or small he can found a Consultation for Nurslings. There is nothing costly nor complex in Professor Budin's methods. All that is necessary is an apparatus for sterilising milk, a balance, and the energy of a medical man. The Consultation may be divided into a paying and a gratuitous section, so that it will be self-supporting. The safety of almost every infant can be ensured, and diarrhœa, marasmus, rickets and other dietetic diseases banished from the community. A little care and a little patience are the only

essentials for complete success. The results will amply repay the labour. Each year will see the infantile death-rate diminish and the number of thriving little patients increase. Physical degeneration will cease to threaten the race, and a dreary burden of misery and suffering will be lifted from the drooping shoulders of motherhood.

I wish humbly to express my deep sense of gratitude to Sir Alexander R. Simpson, to whose kindly counsel and help I have been so often a debtor. I was privileged to have the able assistance of Dr. James Dawson in correcting the translation in manuscript, and I beg gratefully to acknowledge his invaluable aid. My best thanks are due to Dr. Peter M'Ewan, Assistant to the Professor of Surgery, Edinburgh University, for revision of the proofs ; to Dr. Barbour Simpson, Senior Assistant to the Professor of Midwifery, Edinburgh University, for many valued suggestions ; and to Dr. Edward Burnet for much kind help in seeing the book through the press.



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## INTRODUCTION

IT was an infant about five weeks old that the aged Israelite held in his arms in Herod's temple when he said: "Mine eyes have seen Thy Salvation." The Infant had to be saved from Herod's sword.

All the great thoughts that have emanated from human brains, all the great works erected by human hands, we owe to those who were once infants ready to perish. So easily does the new-born child die that Bergeron is cited in this book as saying that it has less chance than a man of ninety of living for a week—less chance of living through a year than a man of fourscore.

Sometimes it comes into the struggle for life with the handicap of premature expulsion from the womb. On December 25, 1642, a widow at Woolsthorpe, in Lincolnshire, whose husband had died a few months after their marriage, gave premature birth to a posthumous male child. He was so weak that two women sent to fetch a tonic to revive him did not expect to find him alive on their return. He was so small that he could have been put into a quart mug. So in after days his mother told him. When he grew to manhood he saw an apple fall from a tree in the Woolsthorpe garden; he pondered the matter; by-and-by he propounded the law of gravitation. Sir Isaac Newton was rescued from his infant danger by his mother's love. But who may tell how many an undeveloped philosopher has perished from lack of an intelligent mother's care?

In countries like our own, with a dwindling birth-rate, it becomes a matter of urgent necessity to discover and develop means for reducing infantile mortality. There are two departments of Puericulture—the study of (1) the Production and (2) the Preser-

vation of children. France, which suffers in a very marked degree from shrinkage in the birth-rate, is fortunate in having the two chairs of midwifery in its metropolitan university filled by men who have devoted supreme ability and unwearied industry to the two sides respectively of this important subject. Professor Pinard has occupied himself with excellent results with the Eugenic aspect, which has regard to the conditions that foster and favour antenatal life.

In this volume Professor Budin explains in ten lectures to his students the methods he has found successful for preserving the life and promoting the growth of the Neonate. The first four concern the premature and the specially feeble; the other six have regard to the full-time child. The story he has to tell of his victorious battle with infantile mortality is of thrilling interest. It must arrest the attention not only of the physician, but of the philanthropist and the patriot. It is high time the tale should be told in the English tongue.

I have from time to time suggested to young graduates that they should visit Professor Budin's Clinique and learn and teach the value of his Consultations for Nurslings. The work has at last been undertaken by Dr. Maloney.

In Paris, between thirty and forty years ago, I talked with a young obstetrician, who was taking part in *Concours* that were then in progress for some coveted appointments. I asked if he had not thought of going in for what seemed to be the most desirable of all. "That would be useless," he replied. "Budin is competing for it, and we all know that nobody can stand against him." Three or four years ago, in the Dean's office in our University, I came across a student so well known among his fellows for his ability, that men who had put down their names as candidates for scholarships came and asked that they should be dropped from the list, because they had learned that Maloney was their competitor. In the last year of my tenure of the professorship of midwifery he gained the James Scott Scholarship as the most distinguished graduate of the year in my department, and thus became entitled to the position of House Surgeon in our Maternity, where he

began to get practical knowledge of the dangers and difficulties that meet the new-born child. He went to Paris to study under Professor Budin, and at once grasped the importance of Budin's discovery, and was grasped by the interest of it. The result is this translation of Budin's Lectures on *The Nursling: Its Diet and Hygiene*.

Professor Budin is a past master in the eloquent use of the most lucid of modern languages, and his Lectures form most delightful reading; while the telling graphs, with their curves and columns, dotted and shaded and coloured, with which he illustrates his pages, serve to relieve the strain which most minds feel in dealing with a long array of figures. If Dr. Maloney's translation is not slavishly literal, it is only on that account the more fitted to gain the reader's attention and secure an interest in his master's ideals and practice.

But what is Professor Budin's discovery? Why, just that we need not let infants die in the numbers that are our reproach—that an arrest can be, and has been put, on the wastage of infant life.

Whilst in Paris from 1897–1904 the infantile mortality amounted to 178 per 1000, the infant loss among those cared for at his Consultation for Nurslings was only 46 per 1000. At Varengeville-sur-Mer a Consultation for Nurslings was founded by a benevolent lady, and superintended by Dr. Poupalt of Dieppe. During the seven years before 1904 infantile mortality there averaged 145 per 1000. In 1904–5 not one infant cared for at Madame Rolle's Rescue died, and the general mortality in Varengeville fell to 77 per 1000. In 1898, when the same high summer heat had prevailed as in 1904, the mortality of infants under a year old had amounted to 285 per 1000. More than 200 infants were thus saved to that community in one year by those who acted on Professor Budin's teachings.

It was in 1892 that Dr. Budin established his first Consultation for Nurslings in connection with the Charité where he was charged with the obstetrical service. At the Maternité to which he was promoted later, and at the Tarnier Clinique, which



he now directs in succession to one of the greatest obstetricians of the nineteenth century, he has continued to create and develop them. Instituted at first in the interest of the infants born under his charge, they are now attended also by mothers who have been confined in private, but have learnt the value of the training and assistance imparted at the Consultation.

The infants are brought by their mothers once a week for inspection. They are examined carefully—by thermometers, &c., if need be; but, above all, they are systematically weighed. The mothers have been provided with a card, numbered in correspondence with a register kept in the institution of all important facts bearing on each infant's progress. Her card keeps for her the record of her child's weight, and on it is noted the kind and amount of food that experience has shown to be necessary for its healthy development. Great stress is laid on the pre-eminent value of breast-feeding, and women who have begun by thinking they were unfit to suckle their children have been taught, to their delight, to find that they could become efficient nursing mothers. When their supply is insufficient they are taught with what milk, and in what proportions, to supplement it. In a certain proportion of cases they have to be taught how to feed them entirely from the bottle. For many, an appeal to the Board of Public Assistance brings a gratuitous supply of the prescribed aliment. Mothers begin to take an intelligent interest in the sublime duties of motherhood. As they wait their turn there may be rivalries as to which baby is advancing best. The more experienced women encourage the younger to perseverance. A woman corrected one Friday as to the treatment of her child will remind the doctor next Friday of the scolding he had administered, and bid him note that it has been attended to. Dr. Henry de Rothschild calls the Consultation for Nurslings a School for Mothers. These were the mothers Napoleon said France was in need of. The Consultation is also an Infant Rescue.

Dr. Dufour of Fécamp was one of the first to follow Dr. Budin's example. Under the fanciful designation of *The Drop*

*of Milk*, he established an infants' dispensary, where he obtained the gratifying result of reducing the infantile mortality from enteritis to 2.8 per cent., when the mortality from that cause in Rouen, Bolbec, and Havre was as high as 76.6, 66, and 51.2 per cent. respectively.

Similar dispensaries, usually described as *Consultations de Nourrissons*, and sometimes as *Gouttes de Lait*, have been widely established throughout France. They may be attached to hospitals, crèches, or other benevolent institutions, or placed on an independent footing. They have extended to the French colonies, and we are told that amusing photographs have come from Madagascar of Malagasy women watching the weighing of their babies. They are finding their way into Belgium, Spain, Hungary, Italy, North and South America.

Their beneficent results in France are such that in a recent discussion at the Academy one of the speakers declared that Professor Budin had been the means of saving a battalion from the slaughter-field of infancy. A young doctor who sustained his inaugural thesis on the success that had attended a *Consultation de Nourrissons* he had organised at Nancy, wrote: "It is by this means alone that we shall cease to witness the hecatombs of infants entered on our official statistics; the remedy has been found; to refuse to make use of it would be a crime."

If, in the days of the rising generation, folly should be allowed to over-ride wisdom, and the dogs of war howl down the counsellors of peace, the place that France would take on emerging from a great world-strife might depend largely on the strength of Budin's battalion.

As I have read his proofs I have been tempted to envy Dr. Maloney the opportunities of the years that lie before him. When I look back on my own professional and professorial life no memory stings me with more sharp regret than the thought of the too little heed I have given to the needs of the Neonate.

I account it a great privilege to have been allowed to write these paragraphs by way of introducing to English readers the stirring lectures of my illustrious colleague. If they should lead

some of my old students and their fellow-practitioners throughout the British Empire and the English-speaking world to lay to heart Professor Budin's teaching, and to carry out in their spheres of influence his practice—if I could be sure of this—it would go far to help me to say my *Nunc Dimittis* with something in my soul of old Simeon's peace.

A. R. SIMPSON.

52 QUEEN STREET, EDINBURGH,

October 16, 1906.



# THE NURSING

## LECTURE I

**SUMMARY:**—Considerable decrease in the mortality and morbidity of childbirth—Growing interest of accoucheurs in infants.

Infants affected with congenital debility, or weaklings—Definition—Description—The department for weaklings at the Maternité—What must be studied in weaklings: (1) their temperature and their chilling; (2) their feeding; (3) the diseases to which they are specially exposed.

Temperature of weaklings—The fall of temperature immediately after birth—Ease with which a fall takes place.

Mortality among infants weighing 2000 grams or less, in whom, on admission, the rectal temperature was equal or inferior to  $32^{\circ}$  C.—Mortality in infants weighing 2000 grams or less, in whom the rectal temperature oscillated between  $32^{\circ}$  C. and  $33.5^{\circ}$  C.—The necessity of taking into account the infant's weight and temperature.

Means of combating a fall of temperature—Older methods—Tarnier's incubator and its modifications—Other incubators—Temperature of an incubator—When may it be dispensed with?—Clothing of babies in incubators—Rubbing—Massage—Use of hot baths in cases of depression of temperature.

Principal causes of lowering of temperature in weaklings and full-term children—Preventive measures for the newly born.

GENTLEMEN,

Medical interest in the welfare of infants is of comparatively recent development. Formerly, the birth of a child was an ordeal of life and death to the mother; and the accoucheur, engrossed in her safety, scarce spared a thought for the infant. Nowadays, thanks to antisepsis, death has practically been banished from our maternity hospitals, and morbidity reduced almost to its minimum. Further, through the perfection of instruments and the advancement of operative technique, obstetrical interference has become much simpler and safer, so that the accoucheur, freed from anxiety as to the fate of the mother, can now devote his attention to the needs of the infant. Before parturition, he supervises the hygiene of the expectant mother so that she may arrive at term in a healthy condition; during delivery, he takes every precaution to ensure that the child will be born sound and viable; and throughout the first two years of life, he directs its feeding with the utmost care.

I intend, therefore, this year, in addition to the usual lectures on Practical Obstetrics, to devote a certain number of meetings to the consideration of the infant. I propose to study with you, successively—

1. Infants born before term, *i.e.* congenitally feeble infants.

2. Infants born at term and their care in the Maternité.

3. Infants after they leave hospital. In this connection I shall describe to you the constitution and function of Consultations for Nurslings which are being established throughout France. A considerable movement in this direction has taken place of late years, important results have been obtained, and great advances have been made. You will learn what practical experience has taught us relative to the feeding and weaning of infants, and the knowledge of these matters will prove indispensable to you as medical men.

We shall begin with the study of infants affected with congenital feebleness. They are classed as *weaklings*, and are, as a rule, the product of a premature labour.

Infants born at full term weigh on an average from 3000 to 3500 grams. Those born before term weigh less, and all between 1000 and 2500 grams are considered to be congenitally feeble. We shall not discuss infants of less than 1000 grams. They are seldom saved, and only very rarely shall I need to allude to them.

We must not, however, base our estimate of an infant's vitality solely on its weight. Some born prematurely have quite a considerable weight, mainly accounted for by the presence of excess of fat in their tissues. These infants do not, as a rule, live long; their pulmonary apparatus functions imperfectly and their digestive tube does not permit of assimilation. On post-mortem examination their organs are found to be more or less incompletely developed.

On the other hand, there are tiny, puny infants with great vitality. They seem never to rest. Their movements are untiring and their crying lusty, for their organs are quite capable of performing their allotted functions. These infants will live, for although their weight is inferior to that of those we have just mentioned, they have a greater power of resistance, for their sojourn in the womb was longer.

To appreciate the vitality of infants born before term, it is necessary, therefore, not only to take into account their weight, but also the length of time they have remained in the uterine cavity.

Infants affected with congenital debility present certain external characters which I shall briefly recall to you.

The body is small and puny ; the skin is soft and of a vivid red ; the dermis is transparent, allowing the blood vessels to be seen, and the circulatory network through the tissues can be clearly distinguished.

These infants breathe and they even cry, but their respiration is far from complete. As can be seen at the post-mortem examination, it is not really pulmonary, but only bronchial ; the air may penetrate into the large, into the medium-sized and even into the small bronchi, but it does not reach the interior of the pulmonary alveoli.

Further, these infants show a most remarkable degree of muscular inertia : their movements are slow and lagging, their cry without force, and their voice wavering and toneless. Some make feeble and impotent efforts of suction ; but they cannot suck, sometimes they seem not to have even the strength to swallow a few drops of milk trickled from a spoon into their mouths. It is then necessary to use various means, in order to ensure that the nutrient fluid will reach the stomach.

What should be your treatment of such an infant ? In 1853 Hervieux published some interesting researches on what he called "The Progressive Algidity of the Newly Born." He showed that in them the temperature, the circulation, and the respiration became depressed, following a parallelism almost mathematical. Gueniot, in 1872, delivered some important lectures on congenital debility and its treatment. A little later, Tarnier and his pupils, Auvard, Berthod, &c., endeavoured to maintain these infants at a sufficient and uniform temperature by the use of the incubator. Through the influence of Madame Henry, formerly chief midwife at the Maternité, a special department for weaklings was inaugurated at the end of the year 1893 ; of this I had charge from January 1895, till I was appointed to the Clinique Tarnier, in March 1898. During this time I made a special study of infants affected with congenital debility, and my interest in them has continued unabated.

Here, when an infant is born before term, we devote special care to it ; we keep mother and weakling in hospital as long as possible, and allow them to leave only if the progress of the little one is satisfactory, in order to minimise its liability to disease. Unfortunately, mothers cannot always be persuaded to stay long enough for their infants to attain the development of a

full-term child. It has occasionally happened that I have had to readmit to the wards, weaklings whose condition had become critical, after they had been taken home by obstinate mothers.

What I wish, then, to lay before you in this lecture, is the result of my personal observations and researches.

Authorities are agreed as to the essential importance of preventive medicine in early infancy. Hitherto, their efforts have been mainly directed towards two objects :—

1. The care of the digestive tube.
2. The prophylaxis of contagious diseases.

Infants enfeebled by premature birth should be guarded with special solicitude. Not only do they share to a greater extent than full-term children the ordinary risks of infancy, but they labour under a danger which in its intensity is almost peculiar to them. I refer to the great readiness with which they become fatally chilled.

With weaklings we shall then have to consider three points :—

1. Their temperature and their chilling.
2. Their feeding.
3. The diseases to which they are specially liable.

To-day we shall study the temperature of weaklings.

At the moment of birth, the infant at term experiences a slight fall of temperature. If, in the case of a pelvic presentation, a thermometer be introduced into the anus of the fœtus, the temperature is found to be the same as, or slightly higher than that of the uterine cavity ; but from the moment of expulsion, the mercury falls: it passes from  $38^{\circ}$  to  $37^{\circ}$ , to  $36^{\circ}$  C., and sometimes even lower.

This may be due to evaporation from the surface of the body, but more probably, it arises from the fact that the processes of respiration and combustion are not yet fully established and adjusted.

In the case of the full-term child, under favourable circumstances the temperature quickly rises, but what happens to the premature ?

In 1870, Lépine wrote: "I have observed a most striking difference between infants born robust and infants born weak. If they are exposed for some time to the temperature of the labour ward ( $15^{\circ}$  to  $17^{\circ}$  C.) before being adequately clothed, the temperature of the latter falls to about  $33^{\circ}$  C., whilst that of the former remains practically normal. This depression of temperature



in weaklings is, however, only transient, as a few hours suffice for it to return to between  $36^{\circ}$  and  $37^{\circ}$  C. It is quite exceptional if at the end of twenty-four hours this figure is not attained."

The first part of Lépine's remarks is absolutely correct: the second, less so. If the infant be not placed under favourable conditions, the temperature not only falls considerably, but does not easily rise again.

Here is an instance which occurred yesterday. A woman in the wards was delivered at 6.50 P.M., of an infant weighing only 950 grams. As the vaginal temperature of the mother at the moment of delivery was  $37.3^{\circ}$  C., it is likely that the temperature of the infant, in the uterine cavity, was not less. But ten minutes after birth, at 7 o'clock, the thermometer, placed in the rectum of this weakling, did not register more than  $35.1^{\circ}$  C.; the infant was immediately put in an incubator at  $32^{\circ}$  C., which, during the night, was maintained uniform.

At 9 P.M. the rectal temperature of the infant was  $35.6^{\circ}$  C.

11 P.M.	"	"	"	$34.2^{\circ}$ C.
1 A.M.	"	"	"	$34.0^{\circ}$ C.
3 A.M.	"	"	"	$35.2^{\circ}$ C.
5 A.M.	"	"	"	$35.9^{\circ}$ C.
7 A.M.	"	"	"	$36.9^{\circ}$ C.

Here, then, is a weakling whose temperature fell to  $34^{\circ}$  C., in spite of its having been placed in an incubator at  $32^{\circ}$  C. How far would it have fallen if this measure had not been taken?

Formerly, a pathological condition, sclerema, was frequently observed. To-day, we seldom see it, for we do not allow our infants to become chilled. It is characterised by an induration of the skin and subcutaneous cellular tissue. The former is remarkable for its pallor and is cold to the touch; the tissues are hard and wax-like; and at the same time, the temperature is lowered.

This fall of temperature can be carried very far in the hours and days subsequent to birth. Instead of  $37.5^{\circ}$ , the thermometer, placed in the rectum, may show only  $35^{\circ}$ ,  $33^{\circ}$ ,  $32^{\circ}$ ,  $30^{\circ}$ ,  $28^{\circ}$  C., &c. Several years ago, in passing one morning through the wards, I saw a premature infant which showed signs of sclerema. I touched it; it was cold. I wished to take its temperature, but the mercury would not leave the bulb, to register the lowest point on the scale,  $28^{\circ}$  C. Having sent for another, I found the temperature was  $25^{\circ}$  C.

What had happened? The child was in an incubator, but just as the foolish virgins neglected to fill their lamps, so, during the whole night, had the attendant forgotten to renew the warm water. In the ward the temperature had been only  $10^{\circ}$  C., and the infant, in the incubator, had been frozen. Needless to say, it died during the day. Thus, even without being exposed to the outside air, a weakling may die, if precautions are not taken to prevent the temperature of the room in which it is from falling too low in winter.

When I entered the Maternité, in January 1895, I was impressed by the fact that weaklings brought from outside were often in a lamentable condition. Having arranged that the temperature of an infant should be taken when it arrived, I saw how evil an omen was its fall in a premature child.

Many infants who presented a considerable lowering of temperature died within twenty-four, or forty-eight hours; others lived a little longer, but, in spite of all our care, also succumbed. So, when a puny infant was admitted with a marked fall of temperature, I could, almost with certainty, foretell its death.

At the autopsy, we found the tissues of these little beings in a state of fatty degeneration; it seemed as if the cold had laid a deadly grasp on them.

The carelessness of parents is most extraordinary. Infants scantily clad are often brought to the Maternité, not only from Paris, but also from the surrounding districts and even from the Departments. An infant was once sent over a hundred miles to me, and its only covering was a small piece of flimsy material. Such conduct borders on infanticide by neglect. On the other hand, an intelligent midwife, in the neighbourhood of Paris, has several times sent me weakly infants swaddled so warmly as to place me under the most favourable circumstances for saving them.

What proportion of these infants die when their temperature has been allowed to fall markedly?

I can give you the figures for the three years 1895, 1896, 1897, during which I was in charge of the Maternité.

Amongst the infants having, on admission, a rectal temperature of  $32^{\circ}$  C. or less, I shall distinguish two categories:—

1. Those weighing less than 1500 grams.
2. Those weighing between 1500 and 2000 grams.

103 weighed less than 1500 grams: 101 died, only 2 were saved.

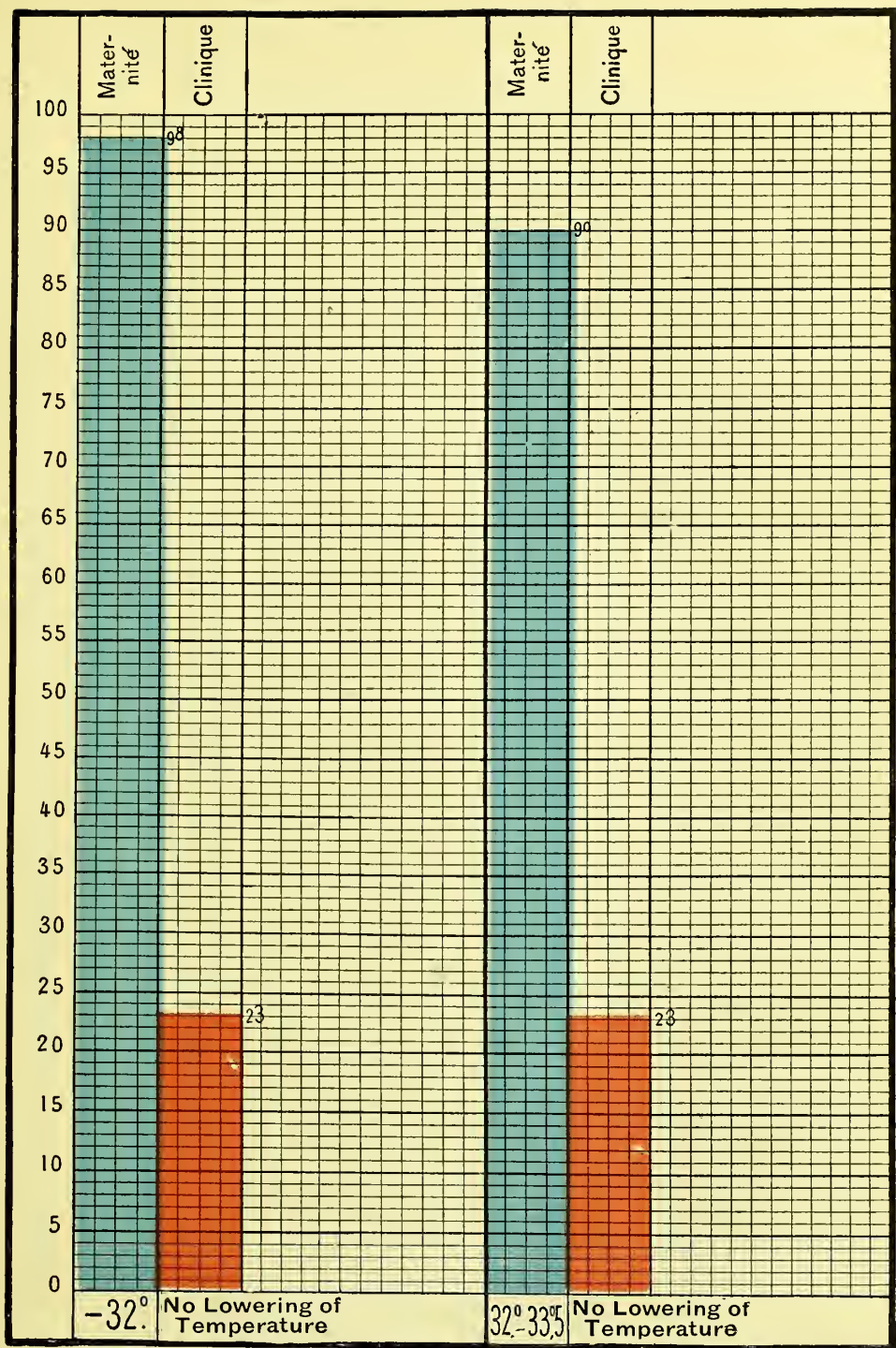


FIG. 1.—*In blue*: Mortality of infants weighing 2000 grams or less brought with depression of temperature to the department for weaklings at the Maternité. *In red*: Mortality of infants weighing 2000 grams or less, born at the Clinique Tarnier, where every precaution is taken to avoid exposure to cold.





39 weighed between 1500 and 2000 grams: 38 died, 1 survived.

This makes a total of 142 infants, of which 139 succumbed.

The mortality, then, has been almost 98 per cent. This is truly appalling. Evidently other causes, such as syphilis and digestive troubles, ought to be taken into account, but the lowering of the temperature played the principal part and rapidly brought about the end.

We have proof of this in the results obtained at the Clinique Tarnier. From the moment of my entry, I insisted on the necessity of preventing the chilling of the newly born, and those congenitally feeble I immediately placed in incubators.

From March 1, 1898, to December 31 of the same year, we had 39 infants who weighed, at birth, 2000 grams or less, and who were, in consequence, from the point of view of weight, in the same position as those at the Maternité. Of these only 9 are dead, 30 have survived. The total mortality, all factors (syphilis, digestive troubles, &c.) being included, has thus been 23 per cent.

In the department for weaklings at the Maternité, among the infants admitted with a rectal temperature of  $32^{\circ}$  C. or less, the mortality was 98 per cent.; but, at the Clinique Tarnier, where the weaklings were not allowed to become chilled, the mortality of infants of the same weight was only 23 per cent.

But, you will say, this fall to  $32^{\circ}$  C. is considerable.

That is true; nevertheless, in three years, 142 infants were admitted in this condition.

Let us take a lesser fall. Let us consider, for example, those infants who had on admission a rectal temperature between  $32^{\circ}$  and  $33.5^{\circ}$  C.

72 weighed 1500 grams or less: 70 died, 2 survived.

83 weighed between 1500 and 2000 grams: 71 died, 12 survived.

Thus, out of 155 infants weighing 2000 grams or less, 141 succumbed, *i.e.* fully 90 per cent. (Fig. 1).

You must not think that weaklings having such a marked depression of temperature are rare; the figures which I have just quoted prove the contrary.

I have shown you that 142 infants, weighing less than 2000 grams, had, at the moment of admission, a rectal temperature of less than  $32^{\circ}$  C., and that with 155 others the thermometer oscillated between  $32^{\circ}$  and  $33.5^{\circ}$  C. This makes a total of 297 infants.

If to these we add 21 who weighed more than 2000 grams, in whom the temperature was equally depressed— $32^{\circ}$  C. in 8,  $33.5^{\circ}$  C. in 13—we have, in all, 318 infants.

As during these three years 1114 weaklings were admitted, 28.54 per cent., that is, nearly one-third, had when they reached us a temperature which scarcely permitted their survival.

It is evident that not only must the degree of depression of temperature be taken into account, but also the weight of the infant. A very small and puny infant offers less resistance to cold than one better developed. This is proved by the figures obtained at the Maternité (Fig. 2).

For weaklings in whom, on admission, the rectal temperature was  $32^{\circ}$  C. or lower the mortality was—

98 per cent. when they weighed 1500 grams or less: 103 infants; 101 died, 2 lived.

97.5 per cent. when they weighed between 1500 and 2000 grams: 39 infants; 38 died, 1 lived.

75 per cent. when they weighed more than 2000 grams: 8 infants; 6 died, 2 lived.

Consequently, with a rectal temperature of  $32^{\circ}$  C., the mortality is higher, the smaller the infants.

For infants in whom the rectal temperature fluctuated between  $32^{\circ}$  and  $33.5^{\circ}$  C., the mortality was—

97.3 per cent. for those who weighed 1500 grams or less: 72 infants; 70 died, 2 survived.

85.6 per cent. for those who weighed from 1500 to 2000 grams: 83 infants; 71 died, 12 survived.

69.2 per cent. for those who weighed 2000 grams and over: 13 infants; 9 died, 4 survived.

Thus, in order to appreciate the power of resistance of an infant, it is necessary to take together into account the degree of depression of its temperature, and its weight. The lower its temperature, the more serious will be a chilling; the less its weight, the more easily will it succumb. This I can conclusively prove by statistics and graphs.

What should be done to protect a newly-born infant from cold?

This question has long exercised the minds of men. Sterne, in "Tristram Shandy," quotes the following passage:—

"The foetus was no larger than the palm of the hand, but the father, having examined it in his medical capacity, and having found that it was something more than a mere embryo, brought

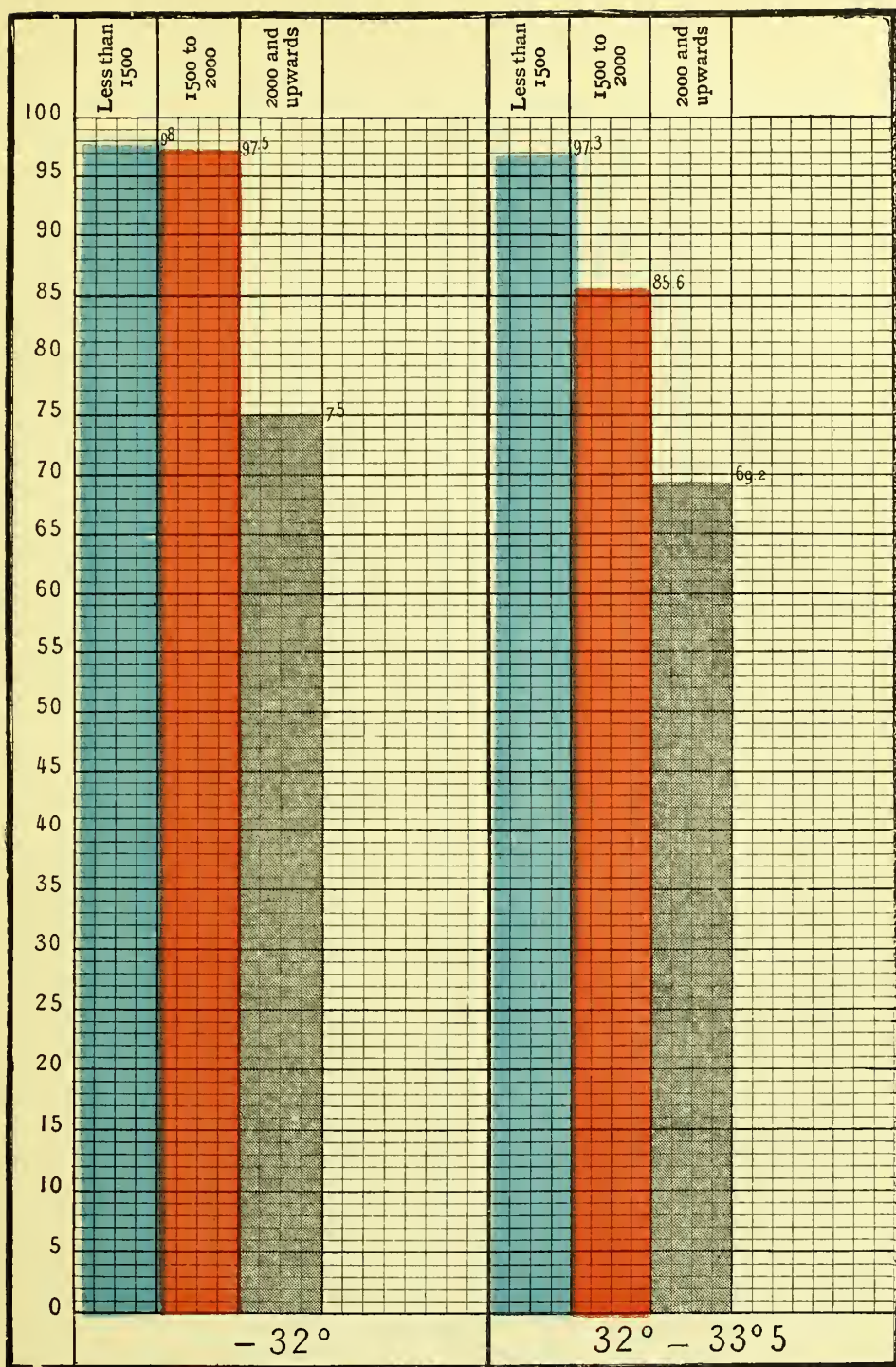


FIG. 2.—The mortality varies according to the infant's weight and the degree of depression of its temperature.





it living to Rapallo, where it was seen by Jerome Bardi and other doctors of the place. They found it was not deficient in anything essential to life, and the father, in order to show his skill, undertook to finish the work of nature and to perfect the formation of the infant by the same artifice as is used in Egypt for the hatching of chickens. He instructed a wet-nurse in all she had to do, and having put his son in an oven, suitably arranged, he succeeded in rearing him, and in making him take on the necessary increase of growth, by the uniformity of the external heat, measured accurately in the degrees of a thermometer, or other equivalent instrument."

In order to hinder weaklings from becoming cold, it used to be the custom, before swaddling them, to envelop the limbs and trunk in a bed of wool; under the bonnet also, there was placed round the head a sheet of wool. Their appearance caused the pupil midwives to dub them "the little woollies."

Two or three hot-water bottles, frequently renewed, surrounded them in the cradle, and their warmth was further added to by blankets, or a little eider-down quilt.

Sometimes they were kept in a room maintained at a uniform temperature of  $25^{\circ}$  C., but it was trying for the mother to stay constantly in a place so overheated. However, in 1877, I thus reared the infant of a celebrated doctor. The grandmother stayed with the little one and tended it, and the wet-nurse entered the room only at the times when the child had to be fed.

In December 1857, Professor Denucé of Bordeaux devised a zinc cradle, with a double bottom and double sides: it was like two baths, a smaller inside a larger, separated from each other by an empty space in which it was possible to put water.

"These two baths," said Denucé, "are united together by their upper edges so as to complete a closed cavity in which water can be received. A funnel is placed at the top, and at the bottom there is a tap by which the apparatus may be emptied.

"The bedding is placed in the cradle; to avoid loss of heat the cradle itself is enveloped in a woollen covering. Hot water is put in the apparatus. Then, by the aid of a thermometer placed in the cradle, as it is easy to add or draw off water, the temperature desired in the interior can be readily established and maintained. Further, with the precaution which I have mentioned of wrapping the cradle in wool, the loss of heat is not great; and in the case in which I employed this apparatus, it was sufficient,

every six hours, to draw off half a litre of water, and to replace it by the same quantity of boiling water."

In 1878 I saw this cradle incubator in use at the "Enfants Assistés" in Moscow. Later, in 1884, Credé published the results he had obtained with it at Leipzig.

The idea occurred to Tarnier to utilise an apparatus similar to that which is used to obtain artificially the hatching of hens' eggs. In 1880, by way of a trial, his first incubator was installed at the Maternité. It has been described by Auvard, and has been working

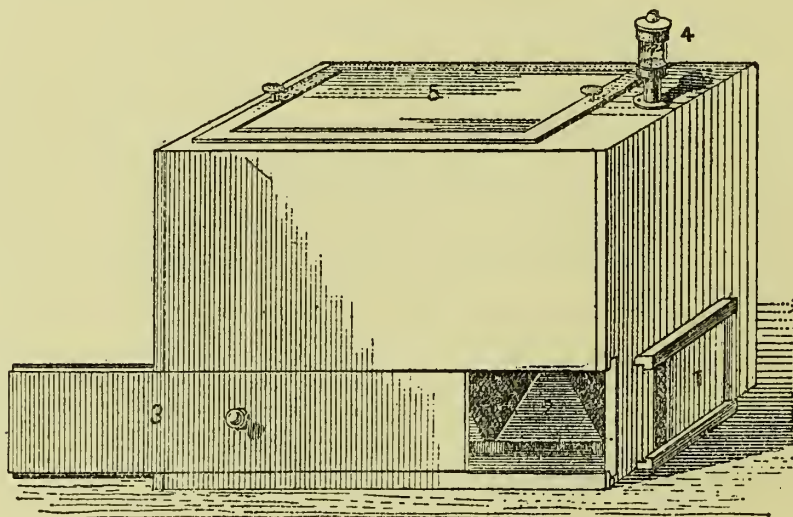


FIG. 3.—TARNIER'S INCUBATOR.

1. Air entry. 2. Hot-water bottles. 3. Sliding door. 4. Air exit. 5. Glass cover.

regularly since November 21, 1881. To the one which had been placed in my wards at the Charité, I adapted, in 1883, a Regnard regulator. A uniform temperature could thus be ensured, for if it rose a little too high a warning was immediately given by an electric bell.

But this apparatus was bulky and dear. Useful in maternities, where it could hold several infants, it was scarcely practical in private work. Tarnier then designed a smaller incubator, simply heated and easily transported.

It is composed of a plain wooden box, 65 centimetres long, 36 broad and 50 high (Fig. 3). The walls are 25 millimetres thick. The interior is divided into two by a horizontal partition, situated about 17 centimetres from the bottom. At one end this horizontal

partition is incomplete, so that air passes easily from one compartment to the other.

In the lower division hot-water bottles are put, either of metal or stoneware.

The child is placed in the upper compartment, on a small mattress which rests upon the separating shelf.

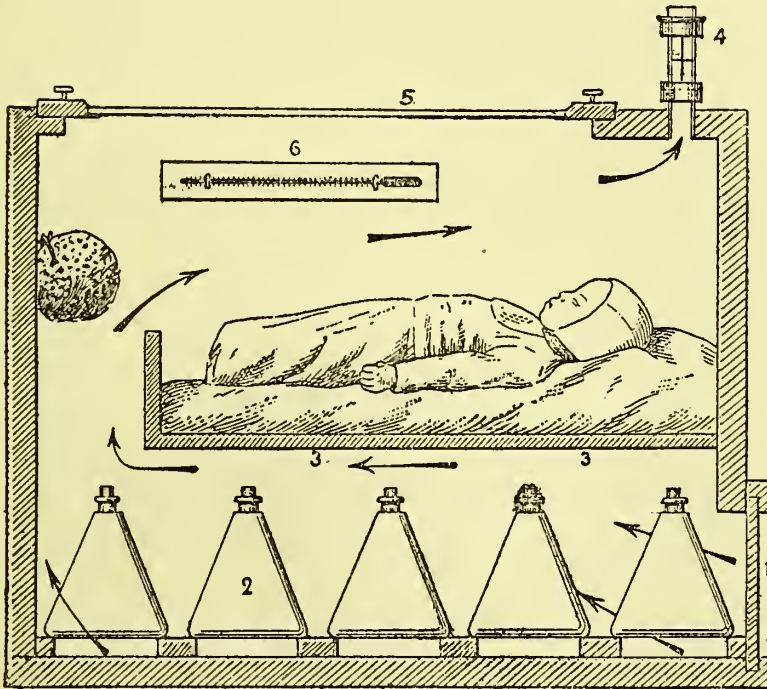


FIG. 4.—SECTION OF TARNIER'S INCUBATOR.

1. Air entry. 2. Hot-water bottles. 3. Horizontal partition on which the infant rests. 4. Chimney for exit of air. 5. Glass cover. 6. Thermometer. The arrows indicate the course taken by the air in the incubator.

The air enters the lower chamber by a trap-door, more or less open, arranged so that it can never be completely shut. As the air passes over the hot-water bottles it becomes heated. Through the space left at the free extremity of the transverse horizontal partition, it gains the upper compartment, where the child is lying, and thence it leaves the incubator by an opening which is guarded by a small chimney.

A large pane of glass is inserted into the top of the box, allowing everything which occurs in the incubator to be seen. It is movable



and can be raised or replaced at will, when the infant needs to be taken out or put in.

The bottles are renewed as often as may be necessary.

These incubators have been still further perfected. It sometimes happens that infants born in a state of congenital debility have attacks of cyanosis which may rapidly prove fatal. Hence it is necessary to watch them very attentively, so the wooden walls of the incubator have been replaced by thick panes of glass fixed in iron frames. The weakling is thus wholly and constantly exposed

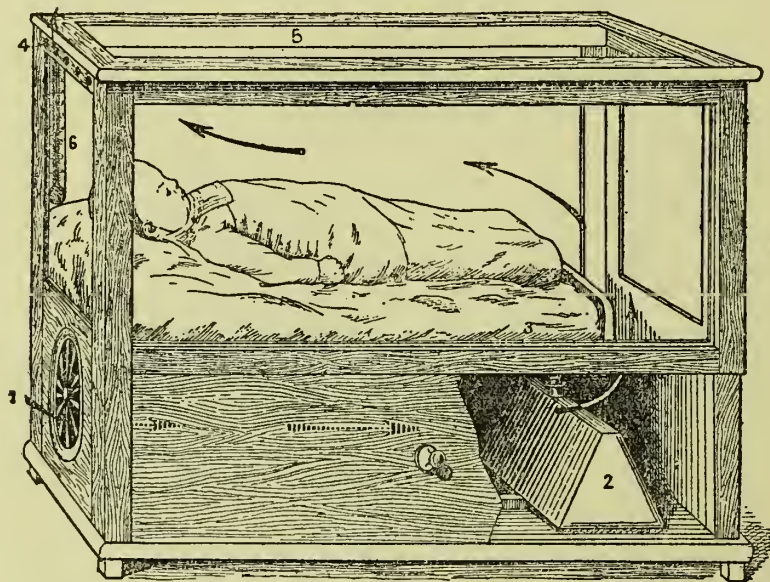


FIG. 5.—INCUBATOR OF WOOD AND GLASS.

1. Air entry. 2. Hot-water bottles. 3. Horizontal partition on which the infant rests.
4. Holes by which the air escapes. 5. Glass cover. 6. Thermometer. The arrows indicate the course taken by the air in the incubator.

to view. In the lower compartment, a large reservoir has been substituted for the water bottles.

Lastly, as these incubators of glass and iron are somewhat dear, they are made nowadays of glass and wood, which is relatively cheap, and allows them to be more easily moved from place to place (Fig. 5).

These last two varieties, iron and glass, and wood and glass, are in daily use in our wards. They are easily cleaned by burning

sulphur in them and then washing them carefully with a solution of corrosive sublimate.

You may also have seen large incubators, the "Lion" incubators, in which infants can be exposed even on a Paris boulevard. Air is obtained from without, and, after being heated with gas, circulates round the infant. This apparatus necessitates the installation of two complete sets of pipes, one to communicate with the outside air, and the other to conduct the gas. This requires time, and is, moreover, a source of expense which cannot be borne by all families. Further, on three occasions, at the Maternité, we were forced to transfer infants placed in them to other incubators. In winter the greater cold requires more gas to heat the outside air ; the longer nights also involve a greater consumption in town and a fall of the pressure in the mains, so that it may often happen, as on the three occasions referred to, that the supply will be inadequate to maintain the desired temperature in the incubator.

Diffre of Montpellier has devised a metallic cradle incubator closed at the top by glass panes. As it is heated by an oil lamp, it sometimes gives rise to a very disagreeable odour, especially if there are several incubators in the same ward. It is very simple, but it is also rather dear.

Professor Hutinel has constructed an earthenware incubator which he uses at "Les Enfants Assistés." It is very easy to render aseptic, but the infant can be seen only through the cover.

In 1885, Professor Pajot, in this Clinique, prepared a chamber as a giant incubator in which to place infants, congenitally feeble, so that they might not be exposed to cold when they were being fed or changed. The wet-nurses, however, were obliged to feed and tend them in this oven ; and the mothers, separated from their infants, soon lost all interest in those whom they were unable to nurse or cherish.

It is better by far to put the little one in an incubator by its mother's bedside. The supervision which she exercises is not to be lightly estimated. We have not always a staff so zealous as the present ; and, if the nurse be negligent, the mother does not fail to remark that the incubator is being allowed to grow cold. Further, it is possible, as you will see, so to arrange that the mother feeds the infant herself, and thus on leaving the hospital not only will the weakling have been saved, but a suckling mother will also have been conserved to it.

At what temperature ought the incubator to be kept ? It used

to be said, between  $30^{\circ}$  and  $32^{\circ}$  C. For my part I consider this much too high, save in certain exceptional cases, such as that of the infant weighing 950 grams, which you saw in the ward. At the Charité, when we were placing infants in incubators at  $30^{\circ}$  C., we often saw them covered with sweat, crying and restless. Their movements were directed to getting rid of their clothing, and we frequently found them lying naked. The temperature was obviously too high, so I reduced it, and I no longer allowed it to rise to more than  $25^{\circ}$  or  $26^{\circ}$  C.

When I took charge of the Maternité, I was much astonished to see that the weaklings in the glass and iron incubators, although the thermometers registered  $30^{\circ}$  C., did not seem to be at all inconvenienced. On observing more closely I saw that each thermometer was placed directly above, and at a short distance from the hot-water reservoir; it was exposed to the action of radiant heat. On moving it to the other end of the compartment in which the infant is contained I found it registered only  $25^{\circ}$  or  $26^{\circ}$  C. This seems to me to be a temperature which is sufficient, except in rare cases, so I have adopted it as my standard for general use.

I consider that the function of an incubator is not so much to provide heat for the infant, as to prevent its losing in too great quantity, that which it, itself, generates.

When a nursling attains the weight of 2280 to 2300 grams, if the room in which it is kept be sufficiently and regularly heated, we allow the temperature of the incubator to fall gradually to  $24^{\circ}$ ,  $23^{\circ}$ ,  $22^{\circ}$ ,  $21^{\circ}$ , and  $20^{\circ}$  C., after which we dispense with the incubator.

Ought weaklings in incubators to be clothed or not? One of my colleagues, having observed that by their movements they tend to rid themselves of their coverings, now leaves them quite naked. But if, perchance, the renewal of the hot water at the proper time be neglected, the infant would become very quickly chilled. It is preferable, while not restricting their movements by swaddling, at least to clothe them lightly, so as to conserve their warmth and yet leave them absolute freedom.

Further, it is beneficial, especially at the beginning, when infants are very puny, to try to increase their circulation by massage. The infant is undressed and placed in front of a bright fire; the fleshy parts of its limbs are lightly rubbed and kneaded, and its joints gently moved by hands previously immersed in hot oil, or moistened with alcohol. These manipulations are continued for about five

✱

minutes, and are repeated two or three times in the twenty-four hours.

When you are called to an infant whose temperature has fallen considerably, is it always sufficient to place it in an incubator? The first essential is to restore the temperature as quickly as possible; and if another fall takes place it must be rapidly counteracted. The use of hot baths, in these cases, is of the very greatest service.

These baths can be given in two different ways. In the one, the infant, having, let us say, a rectal temperature of  $34^{\circ}\text{C}$ ., is plunged into water at  $38^{\circ}\text{C}$ ., and left there for fifteen to twenty minutes: the rectal temperature is found to rise, attaining progressively  $35^{\circ}$ ,  $36^{\circ}$ ,  $37^{\circ}$ , and  $37.5^{\circ}\text{C}$ . The infant is then taken out of the bath and put in an incubator, and the rectal temperature is noted several times, to find the duration of the action of the hot water. In the other, the infant is plunged into water which has a temperature one degree higher than that of its body, that is,  $35^{\circ}\text{C}$ . The heat of the water is gradually increased till it reaches  $38^{\circ}\text{C}$ .; the temperature of the weakling, at the same time, is steadily rising, reaching ultimately  $37.5^{\circ}\text{C}$ . At the end of twenty minutes it is transferred to an incubator. It is found that the temperature of an infant remains much longer near the normal and falls much more slowly, when it is kept for twenty minutes, in water made progressively warmer up to a certain point, than when it is kept throughout in water of the same high temperature.

With newly-born infants in a state of congenital feebleness every precaution should be taken to avoid the lowering of their temperature. When weaklings are brought from other hospitals, the city, or the surrounding districts, to the wards set apart for them at the *Maternité*, they generally arrive, especially in winter, very chilled. If they must be taken from one place to another, they should be carefully wrapped up, and one or two hot-water bottles should be placed beside them. They become chilled with astonishing rapidity. At the *Maternité*, when the mother of a weakling was quitting the hospital, she used to carry her infant to the office to enrol it, before we admitted it to the department for weaklings. As we often found in winter that they reached it with a considerable depression of temperature, a thermometer placed in the rectum sometimes not registering more than  $34^{\circ}\text{C}$ . or even  $32^{\circ}\text{C}$ ., I had to insist on their direct transference from the mother's bedside to the department, and in cold weather I even moved them in their incubators.



Similar measures ought to be taken in private practice. Several years ago I had charge of the tiny daughter of one of our prettiest actresses, born prematurely at Nice, and brought to Paris in an incubator. The infant did not suffer from the journey, and was successfully reared. Yesterday, as one of the mothers here wished her child to be baptized, it was taken in its incubator to the room where the ceremony was to take place.

It is a vital necessity to avoid the exposure of premature infants to cold, as is amply proved by the results obtained at this Clinique, which I cannot too often recall to your minds. In the department for weaklings at the Maternité, among infants brought with a rectal temperature of  $32^{\circ}$  C. or less, the mortality was 98 per cent.: for those with a temperature oscillating between  $32^{\circ}$  and  $33.5^{\circ}$  C., it was 90 per cent.

On the other hand, at the Clinique Tarnier, where the infants were not allowed to become chilled, the mortality was 23 per cent. for infants of the same weight—that is to say, 2000 grams or less.

I might also cite to you the histories of two very instructive cases which occurred in my private practice, the one in 1892, the other in 1898.

In the former, the mother last menstruated during the first week of November 1891. She felt quickening on March 6, 1892. The birth took place on May 14, and, the pregnancy having thus lasted barely six months, I did not consider the infant viable. The father, a doctor, from the first plunged it in warm water, and, seeing it continued to live, he put it in a Darsonval stove which he found in the house. On May 17, the infant, a girl, weighed 955 grams. On May 20, she had fallen to 900 grams. She was fed on a little milk, which from time to time was made to trickle into her mouth from the breasts of a wet-nurse. With infinite care she was successfully reared, but so little did we count on her survival that the declaration of her birth at the town hall, demanded by law, had been neglected, and this gave rise to some trouble with the authorities.

In the latter case, the infant was born on April 21, 1898, with a weight of only 1270 grams. It was warmly wrapped up, and two hours after birth was placed in a wood and glass incubator. Ten days later, May 1, it weighed 1070 grams—a loss of 200 grams. On May 31, it weighed 1550 grams, having gained 480 grams in thirty days. On December 22, 1898, it reached 4800 grams (Figs. 6 and 7).

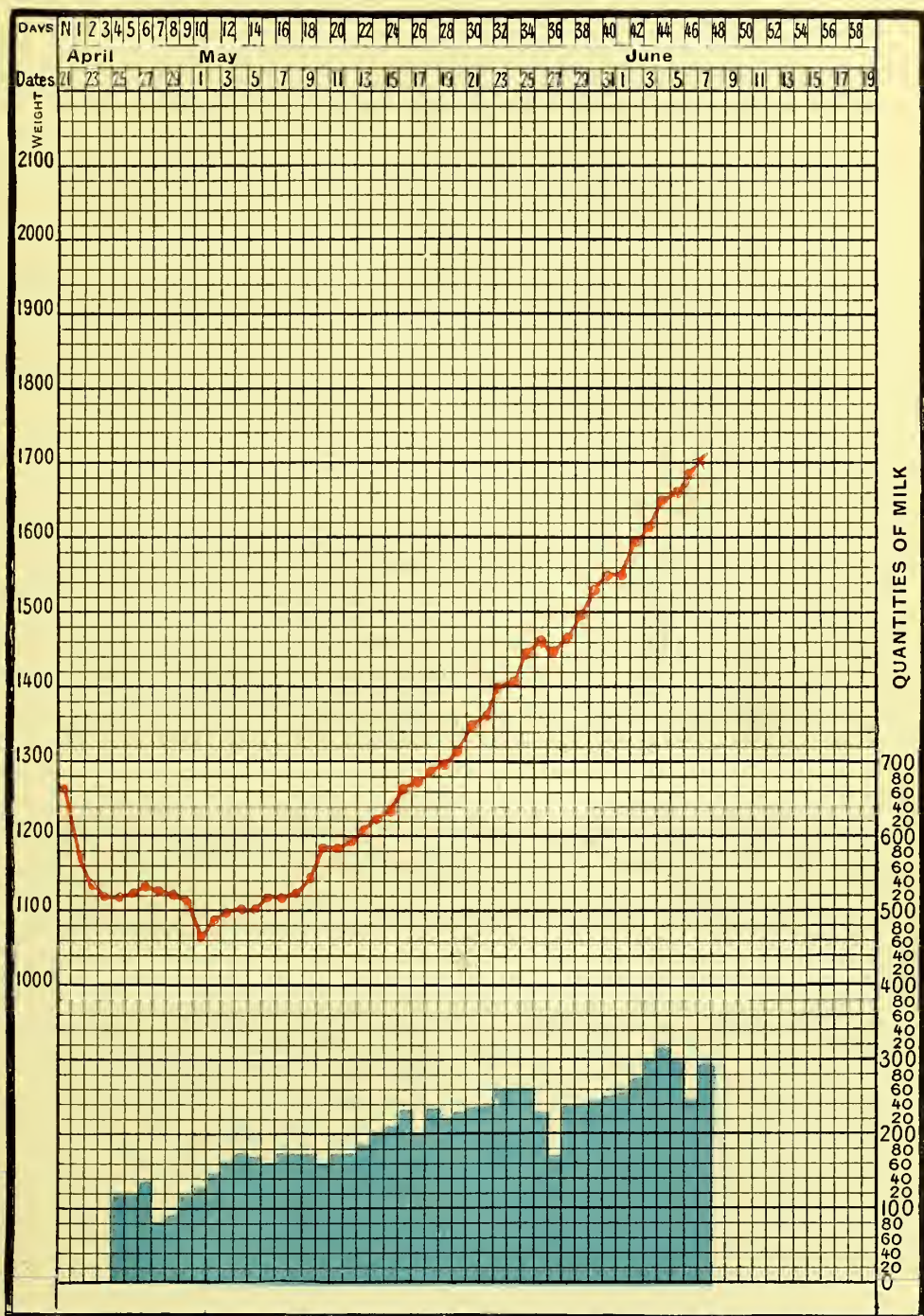


FIG. 6.—Daily curve of an infant weighing 1270 grams. The quantities of milk taken per day are indicated in blue at the bottom of the figure.





There can be no doubt that these two little beings would quickly have perished if they had been exposed to cold. They did not experience any appreciable depression of temperature and they lived.

Infants born at term, although much more resistant, also become chilled very easily, especially in the days immediately following their birth, and the more readily then that they take so little nourishment.

Who has not heard of the numberless infants taken in old days from Paris to be reared in the country? The mortality among them was terrible, for those that did not succumb on the way died rapidly after their arrival, chiefly, in winter at least, owing to cold.

Several years ago, at the instigation of M. Paul Strauss and myself, the authorities ordained that all wet-nurses transporting these little Parisians should not only travel in well-heated, second-class compartments of express trains, which they were not to be allowed to leave till their journey's end, but also, on alighting, be provided with all that was necessary for the warmth of their charges.

The same precautions and supervision should apply to all wet-nurses. They ought to be able on leaving the train, especially when they have still a long journey to reach their village, to obtain a supply of hot water for use in hot-water bottles.

For some years it was compulsory in France to carry all infants to the town hall, there to make a declaration of the birth and sex. This was, during winter, another source of danger from cold, especially in country places where the town hall was sometimes a long way off. Nowadays, in Paris, a medical official visits each house to ascertain the necessary facts, and in the country, it is sufficient to present to the authorities a certificate from the doctor, or midwife, declaring the sex. It is only when the parents, desiring to remain unknown, wish to register the infant as the offspring of a father and mother unnamed, that it must now be taken to a public office.

Although it is no longer obligatory to carry infants to the town hall, they are still taken to church to be baptized. As churches in villages and small towns are often unheated, the risk thereby incurred, especially to weakly infants, is great, yet in their case the ceremony is usually performed earlier lest they should die unchristened.

I have endeavoured to impress upon you the grave dangers of

chilling. The mortality among prematurely born infants when their temperature is allowed to become too much depressed is really appalling, and too great precautions cannot be taken to protect them.

But, however important the external temperature may be, it is not everything ; the infant must, in addition, be enabled to maintain its animal heat by being fed.

The feeding of weaklings is a matter of much difficulty. We shall study it in the next lecture.

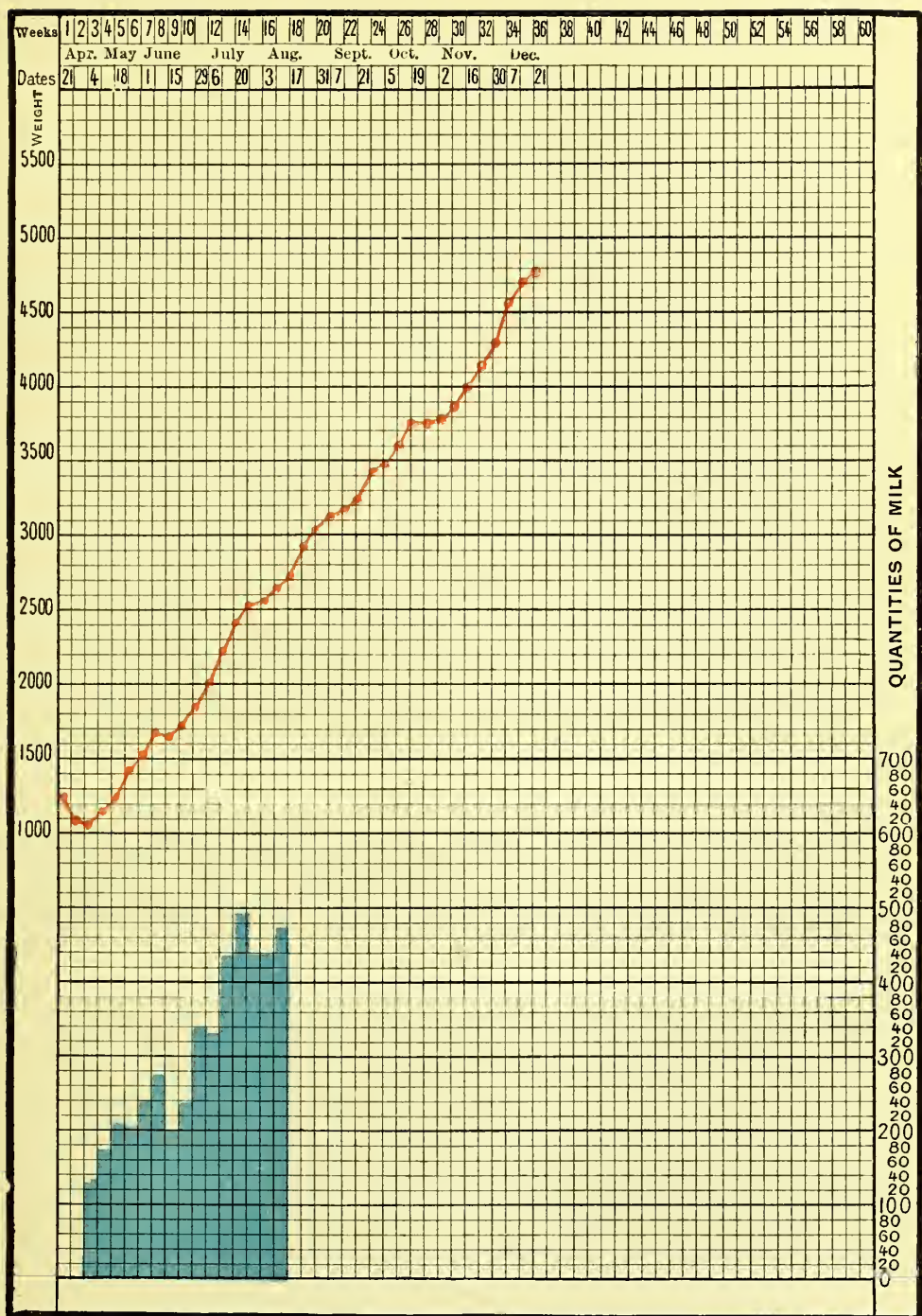


FIG. 7.—Weekly curve of same infant (see Fig. 6). The blue columns represent the average daily quantities of milk taken in the course of each week.



## LECTURE II

SUMMARY :—Synopsis of first lecture—Dangers of chilling, with example—Feeding of weaklings—Anatomical and physiological state of their digestive tract.

Infants attacked with cyanosis—Underfeeding—Examples with curves—Treatment of cyanotic attacks—Overfeeding—Its dangers.

Quantity of milk to be given to weaklings—During the first ten days of life : (1) infants weighing between 1350 and 1800 grams ; (2) those between 1800 and 2200 ; and (3) those between 2200 and 2500 grams—Difficulties when infants do not suck—Gavage—Quantity of milk for weaklings after their tenth day—Rapid method of estimating it.

Infants who take the normal amount—Those who take more—Those who take less—Richness of milk in butter mainly determines amount taken—Importance of the quality of the milk—Diarrhoea in infants.

GENTLEMEN,

In our last lecture I spoke to you of weaklings, *i.e.* infants born before term. I showed you how important it was to pay great attention to their temperature ; I pointed out how rapidly they became chilled ; and I also impressed upon you that cold could injuriously affect the better-developed and more resistant full-term child.

Yesterday, we had a striking example of this. A mother, delivered here several weeks ago, wished, in spite of the cold, to bring her infant to the Consultation. She was extremely anxious to have our advice, as after ten pregnancies this was her only living child. She came from the outskirts of Paris. On arrival, the infant had a sort of cold stroke ; it was dyspnoëic, cyanosed, and had a rectal temperature of  $35^{\circ}$  C. It was rubbed, put in a hot bath, and gradually it revived. It was cared for in the hospital till it had thoroughly recovered, and every precaution was taken to obviate chilling on the homeward journey.

If such serious symptoms can arise in a full-term child of several weeks, from an exposure to cold, it is easy to realise how frequent and fatal is the chilling of premature infants.

The temperature of weaklings must, therefore, be maintained at normal. Thanks to the use of incubators, hot baths, and other means, this may be done ; but it is not the only essential. A living being must generate heat. The infant must produce its



own animal heat, and we must provide it with fuel by giving it food.

You know what takes place. Food is introduced into the alimentary canal, and is there modified by the various digestive juices.

The products pass into the blood and lymphatic vessels of the intestine, and thence are carried to the right side of the heart by the inferior and superior venæ cavæ.

The blood containing the assimilated food-stuffs is sent to the lungs, where it obtains oxygen from the air, and then it returns to the left side of the heart to be propelled throughout the body.

In the midst of the tissues the food-stuffs are brought into intimate relation with the oxygen, and combustion takes place, with the production of heat. To generate animal heat two things are thus necessary: (1) oxygen; (2) substances which can be oxidised or burnt up in the economy. This entails not only a pulmonary apparatus capable of functioning, but also a digestive tube capable of rendering nutritive materials assimilable.

How are these different functions performed in infants born long before term?

There is no doubt that in those who come into the world after only six or seven months of intra-uterine life, the various organs are not fully developed. Respiration at the beginning is purely bronchial, and as it is only little by little that air penetrates into the pulmonary alveoli, the blood is at first imperfectly oxygenated. In the digestive apparatus, the salivary and gastric glands, the liver, pancreas, and intestinal villi are also, probably, incompletely developed. At present, the actual structure of these various organs is still under investigation, and is a very interesting field for anatomical research.

How do the substances elaborated by these embryonic glands act on the food which the weakling ingests? Here, again, is considerable scope for research. What I have said, however, suffices to show you, that an infant born before term is not very fit to carry on the work of digestion and assimilation essential to the generation of its animal heat.

To say that the newly born is only a digestive tube is certainly to exaggerate. Nevertheless, the importance of the alimentary tract must not be under-estimated, for, if digestion and assimilation are not properly performed, the gravest of symptoms, even death itself, may result.



Let us, then, see how infants born prematurely, congenitally feeble, ought to be fed.

Almost from the time I undertook the direction of the department for weaklings at the Maternité, I was greatly impressed not only by the facility with which they became fatally chilled, but also by a curious clinical phenomenon of which, till then, I had had little experience. I observed that a few days after their admission infants frequently had attacks of cyanosis. They suddenly became blue, as if part of the milk they had taken had passed into their air passages, and was choking them. If assistance was not immediately rendered, they died. If, however, energetic measures were promptly taken, they usually revived, although many succumbed to subsequent attacks.

In searching for the possible cause of these cyanotic attacks, I noticed that, as a rule, infants, in whom they occurred, were underfed.

In order to find the amount of food taken by weaklings, they were weighed before and after each meal, and the difference between the two weights showed how much milk had been swallowed. This was marked on a card, and it was only necessary, at the end of the twenty-four hours, to add up these differences to ascertain what quantity had been taken throughout the day. Obviously, there may be occasionally some difficulty in giving a fixed quantity at each meal, but it can be done to within a few grams.

It was thus easy for me to prove that, in general, infants attacked by cyanosis were insufficiently nourished. Here, for example, is the history of a weakling brought to the Maternité, in 1895, and registered as No. 194. It was born in Paris on May 30, and carried to us the same day. On admission, it had a rectal temperature of  $34.9^{\circ}\text{C.}$ , and weighed 1930 grams.

On the sixth day it vomited a little; on the eighth, June 7, it had cyanotic attacks, which recurred on the following days. The infant took very little nourishment, and it was impossible to increase the quantity, for it continued to reject most of the milk given. On the sixteenth day the vomiting ceased, and with it the cyanotic attacks (Fig. 8). During the succeeding days the quantity of milk was increased, but on the twenty-first day the vomiting recommenced, and on the twenty-fifth the cyanotic attacks again appeared. Under these circumstances, the amount absorbed was, perforce, insufficient, and as is seen, on Fig. 8, the quantity of milk ingested was less than that which is indicated

by the dotted line, representing the amount which ought normally to have been taken.

The vomiting ceased at last on the thirty-sixth day. On the thirty-seventh, there was still some cyanosis, but from this date we were able greatly to augment the supply of milk, until we even surpassed the average amount. The infant had no further attacks. It began to grow regularly, and on August 9 left hospital in good health, weighing 2600 grams.

Among my other cases of this affection, there is one with an equally interesting history, for, as it was brought to me in summer, it is impossible to attribute its cyanotic attacks to cold. Born on June 24, 1895, it was admitted on July 3, and registered as No. 231. It had, on entry, a rectal temperature of  $36.7^{\circ}$  C., and weighed 2290 grams. This infant was nourished by its mother. On arrival at the Maternité it had an attack of cyanosis, and others occurred on the following days. It was vomiting, but its stools were yellow. It was receiving insufficient nourishment, as is seen on the curve of the quantities it took (Fig. 9). It soon ceased to vomit, and from July 10, seven days after admission, we were able to increase the doses of milk. The cyanotic attacks disappeared, with the exception of two slight relapses on the tenth day. The infant took more and more each time it was put to the breast. On July 28 it left the hospital, with a weight of 2650 grams, and the mother continued to suckle it.

On August 3 it was brought back, again suffering from attacks of cyanosis. It was not taking the quantity of milk we had laid down as its normal; instead of 560 to 600 grams, it was ingesting only from 410 to 490 grams. More was given, and the cyanotic attacks ceased. The infant left, again in good health, on August 13, weighing 3030 grams.

I am convinced by such cases that cyanotic attacks may arise from underfeeding; and if this origin be proved in any particular instance, then, sufficient food should be given, and, provided vomiting does not interfere with assimilation, the attacks will cease.

What ought to be your treatment in cases of cyanosis in weaklings?

The first thing to do is to put them in a *glass* incubator. I insist on the use of this kind. It is pleasing to the eye; the little inmate is never hidden from the mother's anxious sight; but above all, it facilitates the thorough and unremitting supervision by day and night which these cases demand, for where one attack of cyanosis has occurred the chances are that there will be a second.

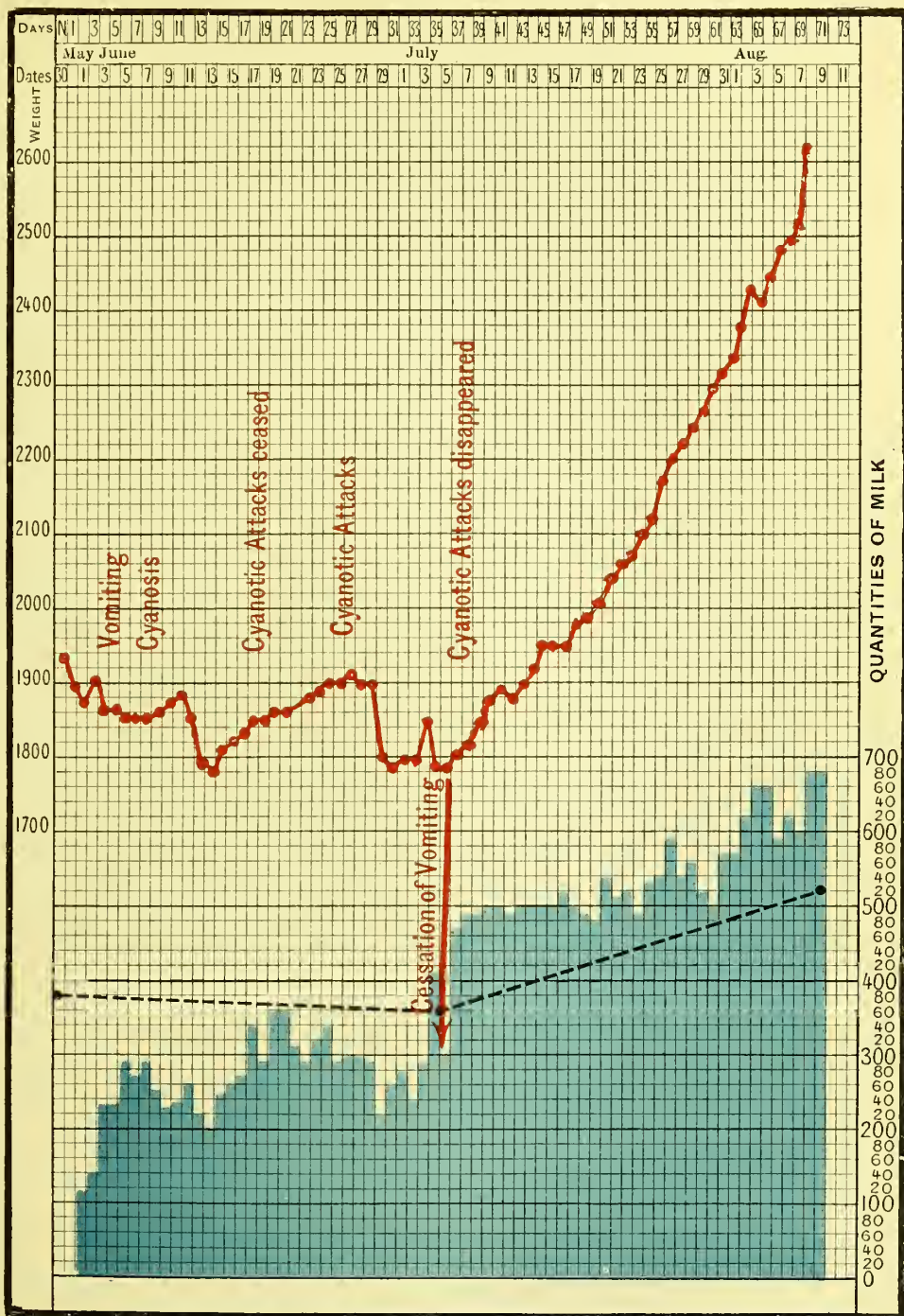


FIG. 8.—Cyanotic attacks in a weakling due to under-feeding. The blue columns, which represent the daily amount taken by the infant, do not attain the interrupted line, which indicates the minimum amount required by an infant of this weight. The attacks ceased when the infant was adequately fed.







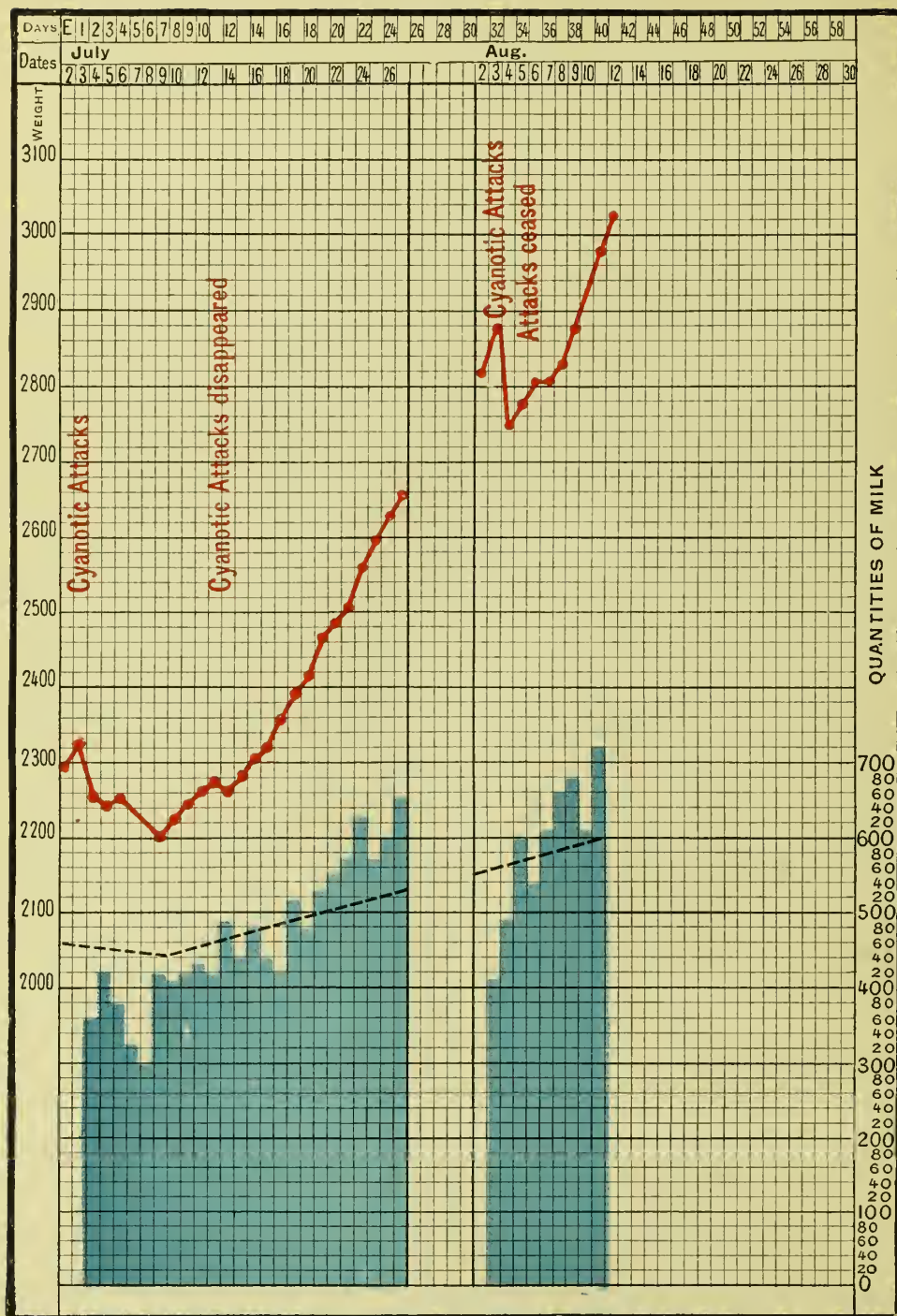


FIG. 9.—Attacks of cyanosis disappear immediately a weanling receives sufficient nourishment. The blue columns indicate the quantities of milk taken per day. The interrupted line shows the minimum required.



When an attack takes place the weakling must be lifted out of its incubator, and everything tried to bring about the re-establishment of the respiration. It should be undressed, and friction applied to the limbs and trunk. Too great force must not be used for fear of injuring the delicate abdominal organs, especially the liver. Rhythmic pressure should be made on the thoracic walls, and if the mouth contains any mucus, it should be cleared out. Sometimes it is of service to hold up the infant by the legs, head downwards, so as to determine an afflux of blood to the brain, and I have had recourse with success to insufflation in a few cases. When breathing recommences the infant is plunged into a hot or a stimulating bath. After it has fully recovered, it is put back into the incubator. Oxygen, supplied through a funnel, the large opening of which is placed beside the infant's face, may then be used with advantage.

Afterwards, it is necessary to supervise the feeding with a view to increasing the amount absorbed. If the child does not wish to take the breast, or is not strong enough to suck, it must be fed from a spoon, and if it cannot swallow, gavage<sup>1</sup> must be employed.

Sometimes vomiting is present, which forms a very embarrassing complication. We must then give only a small quantity of milk at a time, and compensate by feeding every hour and a half or every hour. Food thus given in small bulk is retained and digested more easily.

I have sometimes given potassium bromide. It is of value when gavage is necessary, as it diminishes the sensibility of the pharynx. A solution is made, which ought to be used within twenty-four hours, containing 20 centigrams of bromide, the amount which can be administered to an infant weighing about two kilograms.

These are the various measures which I have found useful in the treatment of weaklings attacked with cyanosis. Sometimes in spite of all, they die very quickly, but often they are happily saved. The struggle may be long and anxious; in one of the cases I have just cited, four weeks elapsed before success was assured. So never despair.

I have shown you, gentlemen, that infants attacked with cyanosis need more food. When I first proposed to increase their ration, I ran counter to the opinion of my predecessors in the wards, who held that if more was given than these infants wished to take, digestive disturbances would arise and probably cause death.

<sup>1</sup> Gavage—feeding by stomach tube.

"But," I reasoned, "these infants have cyanosis, and one thing is certain, they will die if they are not adequately fed. Is this fatal diarrhœa inevitable? I think not, and, at any rate, it is far better to try to do something than to abandon them to their fate for fear of the visionary risks of treatment."

Perhaps you remember the refrain of an old song :

. . . "puis qu'il nous faut mourrir  
Suivons, au moins, le chemin du plaisir."

In this case, the path of pleasure, for adults, is drinking. May it not be the same for infants? I increased their absorption of milk with, as you have seen, the happiest of results.

You must not think I was giving these infants an excessive diet. I raised their ration only to sufficiency. I wish you to be quite clear on this point, for nothing is further from my thoughts than the advocacy of overfeeding, the scourge of infancy. In the wards, you will often see infants put to the breast at every moment of the day and night. They rapidly swallow large quantities of milk, and at the end of each twenty-four hours the weighings show that they have taken far too much. We are forced to keep them apart from their mothers. We allow them to suck only at stated intervals, and for a few minutes at a time. Under this dieting any digestive troubles disappear, diarrhœa ceases, and the infant's weight increases normally. Only this morning, you saw a woman weeping in the wards because her infant, overfed, and, in consequence, indisposed, had had to be separated from her. Weaklings are more readily affected by excessive diet than full-term infants. Let me give you a typical case.

An infant, No. 157, born on March 11, 1895, was brought to the Maternité on March 26, with a weight of 2120 grams. This weakling, who has a fine curve (Fig. 10), was a source of great concern to me for some time; its stools were liquid, almost quite green, and only partially digested. It increased in weight, but its digestion remained far from good. At the bottom of the figure, you will see the total amount of milk it took each day. This greatly surpassed that which it should normally have absorbed, according to its weight, and which you see indicated by the dotted line. Little by little, however, I reduced the amount to what it should have been, and the stools gradually improved.

These overfed infants suffer from indigestion and diarrhœa, and they very quickly lose weight. It is only by careful dieting that their digestive tube can be restored to a healthy state.

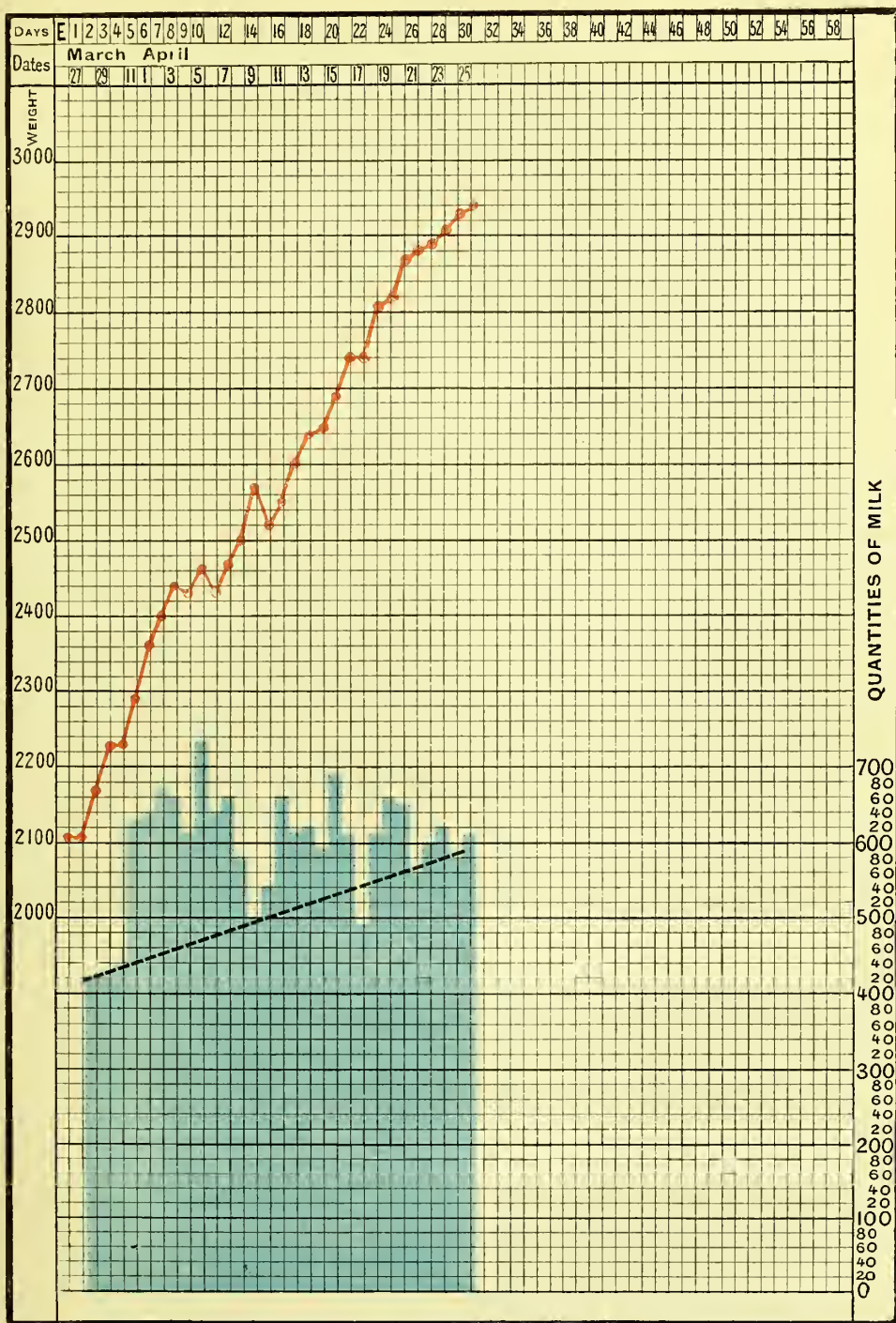


FIG. 10.—Weanling taking excess of milk and increasing in weight at an abnormal rate. Digestive troubles arise, and disappear only when the daily allowance approaches the normal. The interrupted line indicates the normal, the blue columns the actual amount taken each day.



You see in what a predicament you may be! If too little be given, there is the danger of inanition, cyanotic fits, and death; if too much, there is the dread of digestive troubles, which may also prove fatal. The two extremes, overfeeding and underfeeding, must be avoided, so the average quantity of milk for an infant has to be ascertained.

With a view to establishing this average the post-mortem capacity of infants' stomachs, at various periods of intra-uterine life, has been estimated, but this method does not seem to me to be reliable; the walls of the stomach are not inextensible, and after death the organ may be found dilated even when empty.

I have proceeded on a different plan. Every day the quantity of milk taken at each meal by weaklings at the breast was observed: for infants, who for various reasons were not suckled, what was introduced by gavage or otherwise was noted. A simple addition enabled the total quantity taken in twenty-four hours to be thus ascertained.

I accumulated a large number of such observations relating to infants of known weight, taking the quantity of milk sufficient for their normal development. They presented neither cyanosis nor diarrhœa. Their weight increased regularly and adequately, and their daily temperature was normal.

My method, then, was based purely on clinical observation reinforced by the balance and thermometer.

In the days immediately following their birth weaklings do not take much milk, but the amount increases day by day. From the ninth or tenth day, however, it augments relatively at a much slower rate, so it is necessary to distinguish between—

A. Infants during their first ten days.

B. Infants after their tenth day.

A. During the initial ten days of a weakling's life, when all goes well, the weight at first diminishes, then remains stationary, and finally increases.

The quantity of milk ingested becomes progressively greater: quite inconsiderable at the beginning, it augments more and more as the days go on. Since it varies with the infant's weight, I have divided them into three categories:—

1. Infants weighing between 1350 and 1800 grams.
2. Infants weighing between 1800 and 2200 grams.
3. Infants weighing between 2200 and 2500 grams.



Of those in the first category I have 11 observations.

" second " 31 "  
 " third " 25 "

In the following table the average quantities taken each day are reproduced:—

	1. Infants weighing less than 1800 grams.	2. Infants weighing from 1800 to 2200 grams.	3. Infants weighing from 2200 to 2500 grams.
	11 infants.	31 infants.	25 infants.
2nd day . . . . .	115 grams.	128 grams.	180 grams.
3rd " . . . . .	160 "	175 "	236 "
4th " . . . . .	210 "	226 "	295 "
5th " . . . . .	225 "	308 "	335 "
6th " . . . . .	250 "	324 "	370 "
7th " . . . . .	280 "	335 "	375 "
8th " . . . . .	285 "	350 "	385 "
9th " . . . . .	310 "	380 "	415 "
10th " . . . . .	320 "	410 "	425 "

In each category, the quantity of milk absorbed by the infant is seen to augment from the second to the tenth day. It is greater for infants in the second category than in the first, and in the third than in the second.

This is quickly seen on looking at the three tracings at the foot of Fig. 11, where the quantities of milk taken are indicated.

On the same figure, I have placed above each of the tracings of the quantity of milk the weight curve of an infant belonging to the corresponding category.

To represent infants weighing between 1350 and 1800 grams, I have taken the curve of a weakling, No. 662, born at the Clinique Tarnier on May 15, 1898, with a weight of 1690 grams. It was carefully guarded from cold, and it left hospital on June 14, weighing 2050 grams.

For the second category, between 1800 and 2200 grams, the curve is that of an infant born at the Clinique Tarnier, on November 22, 1898; it then weighed 2030 grams. By the tenth day it had attained 2130 grams, by the twelfth 2190, and by the twenty-third, when the mother wished to leave, 2475 grams.

In the third category is found the curve of an infant born on October 31, 1898, weighing 2270 grams; it was kept warm, and it had a very fine curve (see also Fig. 17).

If these three curves be compared, it will be seen that that of



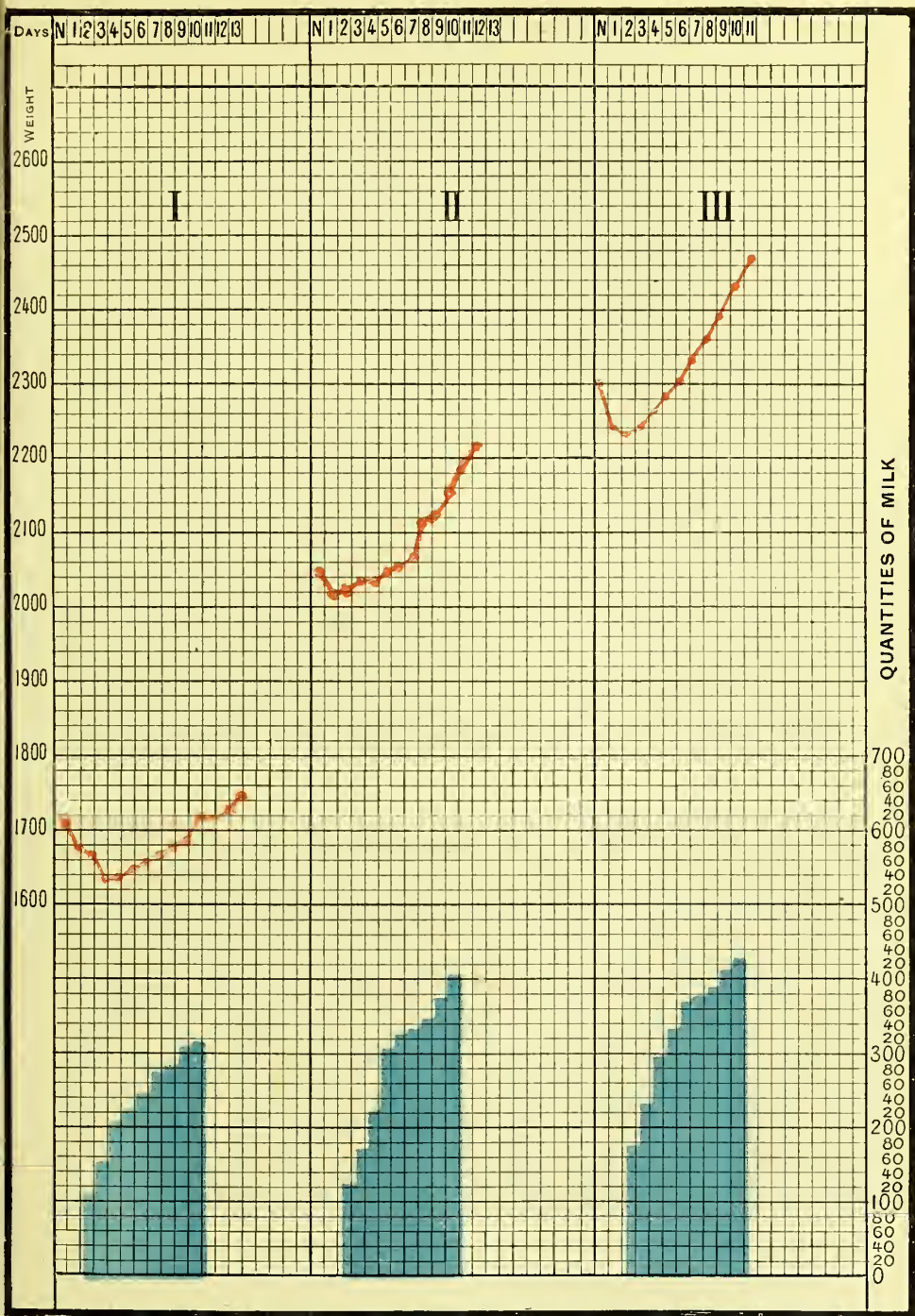


FIG. 11.—The blue columns indicate the quantities of milk which ought to be taken each day during the first ten days of life by (1) Infants weighing less than 1800 grams; (2) Infants weighing between 1800 and 2200 grams; (3) Infants weighing between 2200 and 2500 grams.



the infant in the first category, after its initial fall, has but tardily begun to rise, and has made a slow ascent. The curve of the infant in the second category has commenced to mount sooner, and has risen more rapidly. That of the infant in the third category has risen still earlier, and has progressed still more rapidly.

When infants are smaller than those in our first category, their weight is seen to fall lower; their curve remains longer stationary, and mounts even more slowly. This was well shown by an infant born on April 21, 1898, with a weight of 1270 grams (Fig. 6, p. 16). On May 1 it weighed 1070 grams, a loss of 200 grams in ten days. On May 31 its weight was 1550 grams, an increase of only 480 grams in thirty days. On December 22, 1898, it weighed 4800 grams.

The conclusion which follows from these observations is that little milk should be given to a weakling during the first days of its life, but that the quantity should be increased progressively and according to the weight of the infant, in the proportions indicated on the table of the category to which the infant belongs.

It is possible thus to avoid, on the one hand, the fatal consequences of inanition and cyanosis, and, on the other, digestive disturbances and diarrhœa, caused respectively by insufficient and excessive feeding.

When infants are very tiny, they absorb only small quantities at each meal. In rare cases, it may be of service to make them drink every hour and a half, so that at the end of twenty-four hours they will have ingested the amount adequate to their needs.

When infants are feeble, they sometimes refuse to suck. Milk is then made to trickle into their mouths, directly from the nipple, by exerting pressure upon it, or they are fed from a small spoon, till they become strong enough to take the breast; but, if they allow the milk to dribble out of their mouths, if they do not

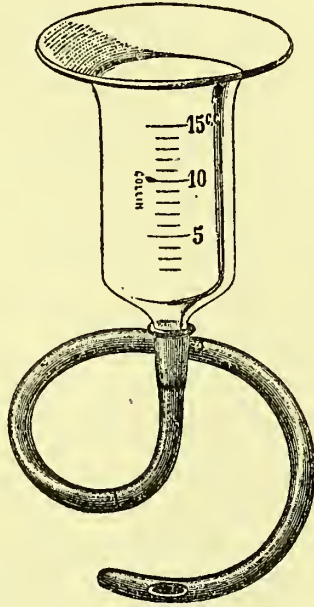


FIG. 12.—Graduated apparatus for gavage.

swallow, or if they reject what is given to them, gavage, feeding by the stomach tube, must be considered.

In March 1884, Tarnier began to practise gavage methodically, but, in 1851, Marchant of Charenton advocated and described the procedure, and his example was followed by Legroux in 1860, Rizzoli in 1861, Fabri in 1865, and Belluzzi in 1870.

The instrument which Tarnier employed was a miniature of that used by Faucher and Debove for washing out the stomach in adults. In 1866 I devised a small instrument for the purpose. It has a glass capsule graduated to 15 cubic centimetres, which enables one exactly to measure the quantity of milk introduced into the stomach (Fig. 12). With this apparatus nothing is easier than to gavage an infant. Tarnier thus described the manipulation: "The tube, having been moistened, is introduced as far as the base of the tongue. After the infant, by instinctive movements, has caused it to enter the œsophagus, it is gently pushed on, till, having traversed a course, including the mouth, of about 15 centimetres, it reaches the stomach. When the tube has been compressed between the fingers, the nutritive fluid is poured into the capsule, and then, on the pressure being released, the liquid, by virtue of its weight, penetrates to the stomach. The instrument is then withdrawn, but, if this is not done by a rapid movement, the nutritive fluid will follow, and be rejected."

We have seen the quantity of milk which must be given to a weakling during the first ten days; but, how much should it take subsequently? When it does not receive enough, its curve, instead of continuing to rise, forms a plateau. If, after assuring ourselves that the digestive tube is quite healthy, and that no pathological condition is present, we augment the quantity of milk, the infant's weight at once increases, and its curve ascends.

Here is, for example, an infant, No. 88, born on February 12, 1895, and admitted on February 17. It then weighed 2390 grams. At first, owing to the passage of the residue of its meconium, it lost weight. Then it began to gain, but after a time, it was found to have become stationary; in four days it had increased by only 20 grams. It was taking a quantity of milk below the proper average for its age: this average is represented by the dotted line on Fig. 13. It was made to take 70, 100, and 120 grams more, and it began at once to put on weight. I should add that it was suckled the whole time by the same wet-nurse.

If, then, an infant does not increase, and you find the functions



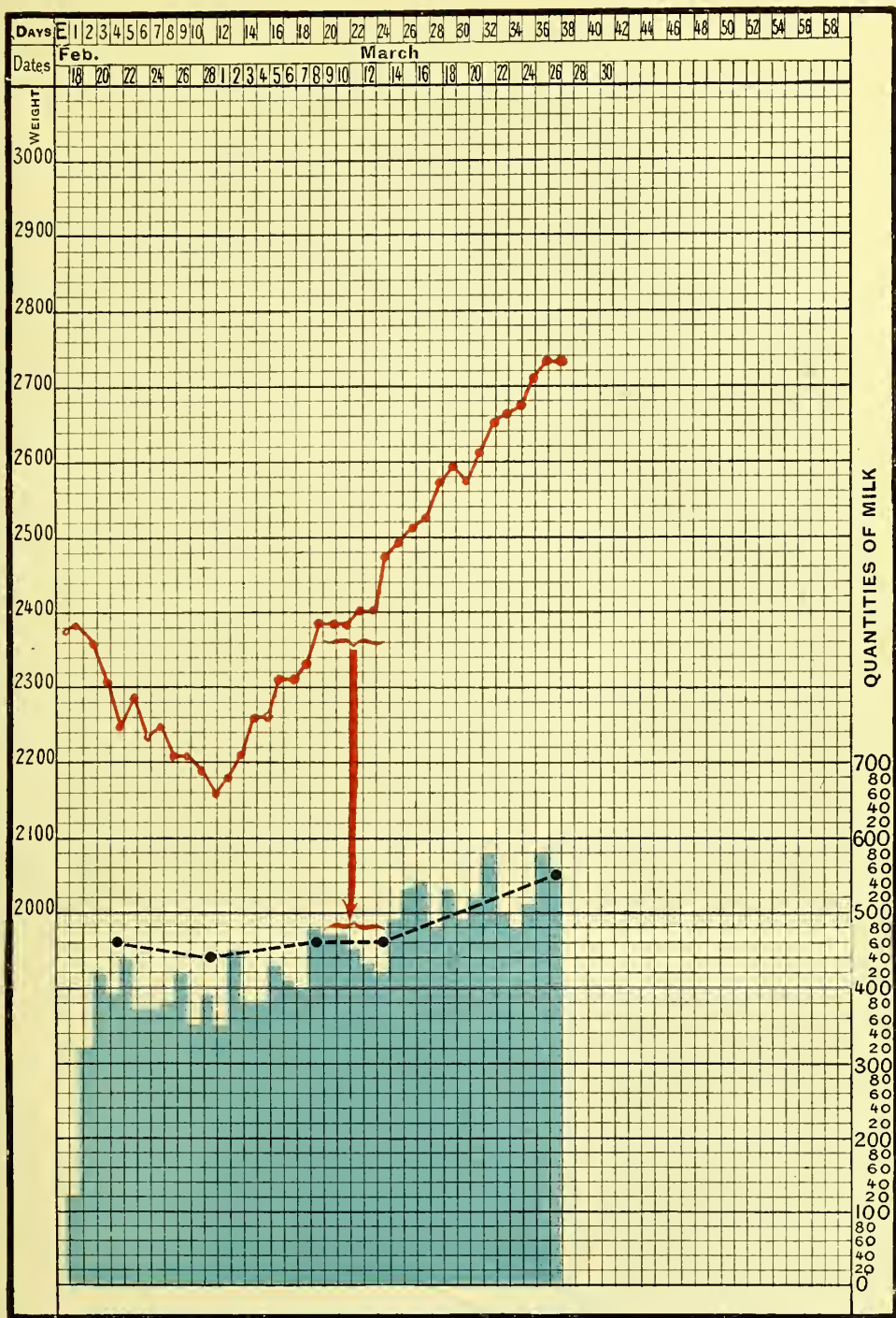


FIG. 13.—Infant taking insufficient milk. It scarcely grows, and remains stationary from the nineteenth to the twenty-third day. The curve becomes normal on increasing the amount of milk. The blue columns represent the quantities of milk taken each day; the interrupted line the average amount required by the infant.







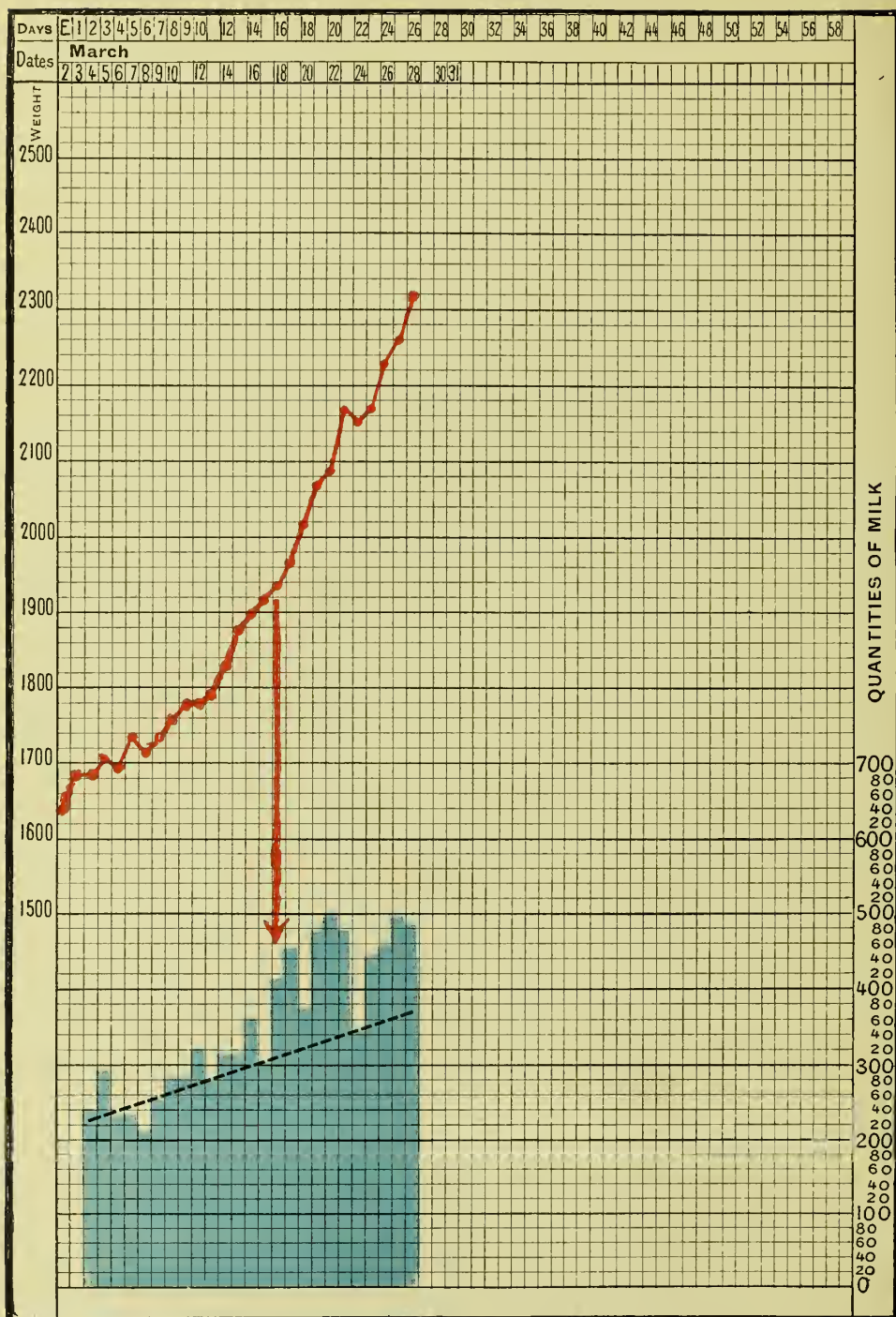


FIG. 14.—A weanling ought to take, in general, a quantity of milk equal, or a little superior to, one-fifth of its body-weight. This average amount is represented by the interrupted black line. The quantity actually taken per day is indicated by the blue columns. Curve taken from day to day.

of the digestive tube being properly performed, but the quantity of milk insufficient, give it more, and its curve will at once begin to mount regularly.

There is a remark to which I attach very great importance, and which I must not omit. If an infant does not take quite enough, it remains stationary. It has no digestive disturbances; its stools are rare, perhaps, but they are perfectly yellow. If more be given, assimilation is rapid, and the weight quickly increases. This observation applies not solely to weaklings, but also to full-term infants, and even to children who weigh five or six kilograms, or more. It is therefore far better at first to give infants too little than too much. If they take too great a quantity, they will assuredly have diarrhoea, and time will be taken up in restoring their alimentary canal to a healthy state.

B. By the observation of many infants, I have been able to fix approximately the quantity of milk, necessary after the tenth day, for those who weigh about 2000 grams, between 1800 and 2500 or 2600, for example. Judging from a great number of facts, which are graphically recorded in the curves I am about to show you, I think that we can find a means of estimating this quantity quickly and with sufficient accuracy.

Let us take, for example, an infant of 2000 grams. Suppress the last nothing, 200 is left. Multiply this figure by two,  $200 \times 2 = 400$ ; that is to say, about 400 grams of human milk ought to be given to an infant of two kilos. I say *about*, for, as a rule, more is needed. Give, then, 400 grams, with a small quantity—20, 30, or 40 grams—in addition, always provided that the alimentary tract is healthy, and you will find that such infants under your care will steadily increase.

Let us take as another example an infant of 2500 grams. Suppress the last nothing, you have 250. Multiply this number by two,  $250 \times 2 = 500$ .

You ought to give this infant 500 grams of milk plus a small amount, which will vary according to certain conditions, such as the quality of the milk and the assimilative powers of the digestive tube.

It is by the accumulation of many observations that I have arrived at these figures. I must tell you at once, they are true only for infants weighing about 2000 or 2500 grams. They are no longer applicable above 2800 grams, as infants over this weight

take a quantity relatively smaller. If, for example, an infant weighed 4000 grams, I would not say it ought to receive 800 grams of milk. This would be altogether too much. These figures, therefore, apply only to healthy weaklings, weighing between 2000 and 2500 grams, and larger infants require proportionally less.

The weakling thus requires an amount slightly more than one-fifth of its body weight. Consequently, if its weight be divided by five, the result will be the quantity of milk it should absorb. An infant of 2000 grams would take a little more than  $2000 \div 5$ , *i.e.* a little more than 400 grams.

Here are several cases in support of these figures.

The first is that of an infant (admission number 116) born on February 14, 1895, and brought to the Maternité on March 2. It was given what we have indicated as the average quantity of milk. This amount is represented on Fig. 14 by the dotted line. The exact quantity absorbed each day is shown by the blue columns. The infant increased regularly: its stools were yellow and of normal consistence. Sixteen days after its admission it was taking a little more than this amount. It continued to assimilate well and to augment steadily. In ten days it gained nearly 400 grams, an average of 40 grams per day.

Another infant, born on July 8, 1895, was admitted on July 9, and registered as No. 246. It weighed 1440 grams. After the usual initial fall, it began to increase. Its curve (Fig. 15) indicates its progress from week to week and not from day to day. The quantity of milk taken from the tenth day closely follows the dotted line, which represents what we have laid down as the normal. The infant left hospital in excellent health on September 16, weighing 2990 grams.

Obviously these figures constitute only an average, and have but a relative value. It is necessary to take into account the state of the alimentary tract, the weakling's powers of assimilation, and also the quality and composition of the milk.

There are some infants who take larger quantities and thrive. So long as their digestive tube functions well, one can afford to wait. For example, an infant was born in Avenue Carnot, on January 1, 1898, weighing 2180 grams. At the beginning it lost weight, then it began to gain. On examining its curve (Fig. 16) you will see that from the tenth day it took much more than the average, till it reached an excess of 100 grams. Its alimentary tract was acting

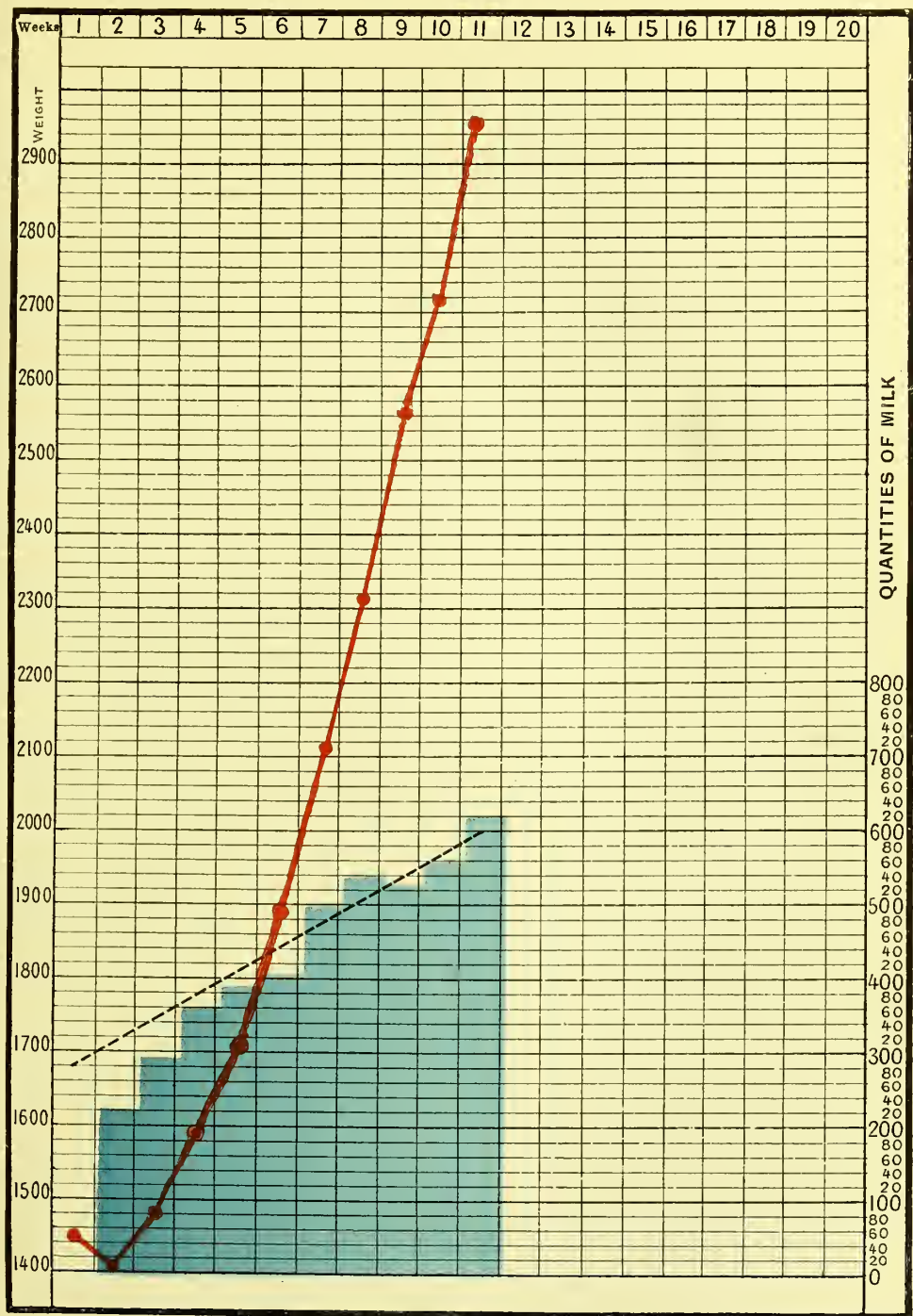


FIG. 15.—A weanling ought to take, in general, a quantity of milk equal, or a little superior to, one-fifth of its body-weight. This amount is represented by the interrupted black line. The blue columns represent the average quantity of milk taken daily during each week. Curve taken from week to week.







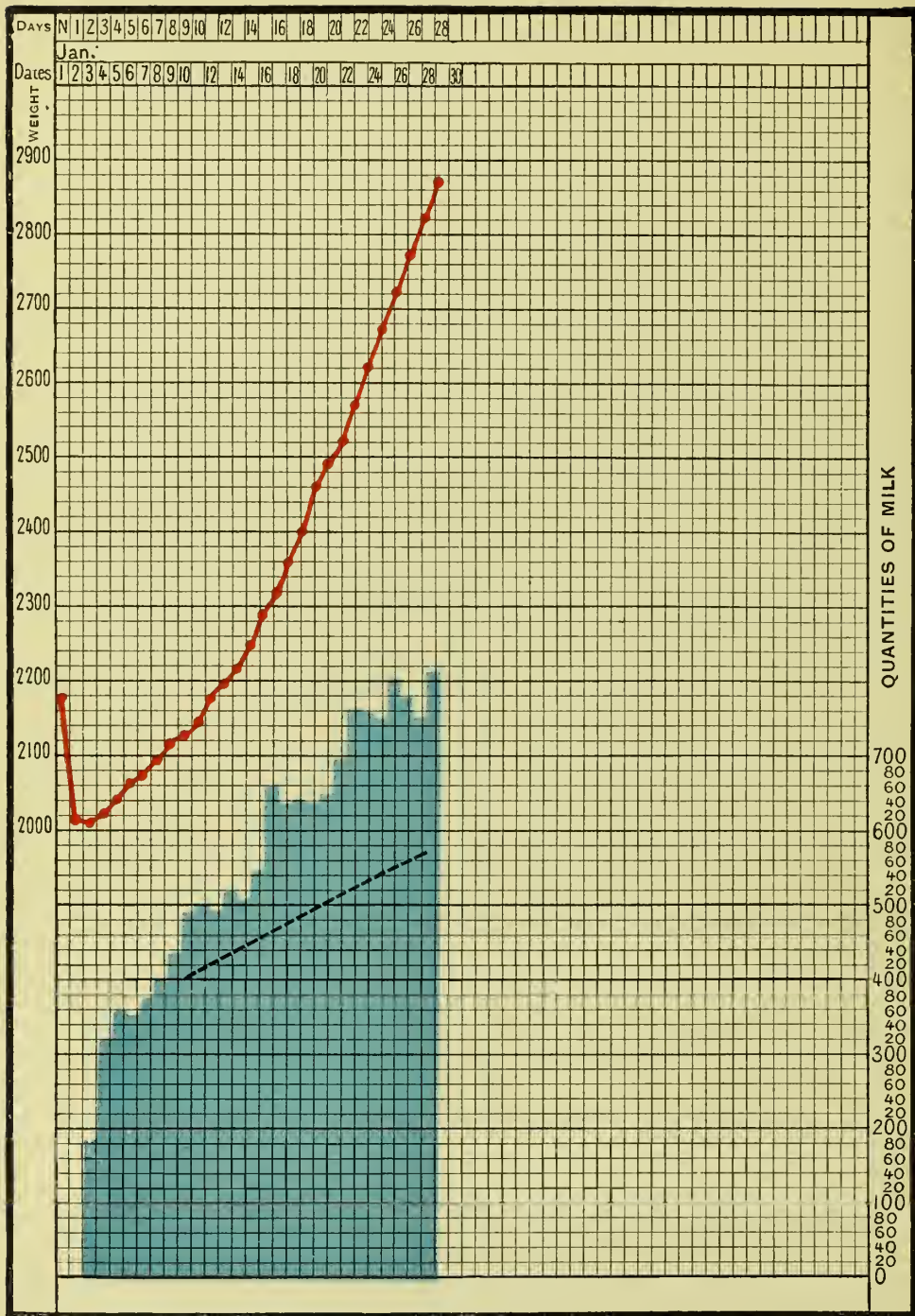


FIG. 16.—Weakling who took the first of the milk flowing from the breast, a milk, consequently, poor in butter. He absorbed a quantity which greatly exceeded one-fifth of his body-weight. Blue columns = daily allowance of milk. Interrupted line = one-fifth of body-weight.

perfectly, so I did not interfere. It increased 700 grams in seventeen days, an average of 40 grams per day.

This weakling was in charge of a wet-nurse, who also suckled her own infant. She made the nursling feed first, so he took the milk less rich in butter, and hence was able to digest a great deal of it without disagreeable consequences.

Other infants, on the contrary, take less than our normal and still augment regularly. This is because the milk ingested contains excess of fat, and is thus more nourishing in smaller volume.

The infant D——, born prematurely on October 31, 1898, weighed only 2270 grams (Fig. 17). After the initial descent it had a rapid rise. It was fed by a wet-nurse, who also suckled her own child, an infant three months old. You see on the tracing that for a certain time Baby D—— took a quantity of milk barely equal, or even inferior, to the average we have laid down. On the eleventh day, for example, when it weighed 2440 grams, it absorbed only 400 grams; but the wet-nurse was suckling her own little one first, so that the nursling was taking the last of the milk, which was very rich in butter; an analysis showed it contained 51.55 grams of butter per litre, instead of 35, nearly half as much again as normal milk. From the point of view of butter, therefore, it was the same as if the infant had taken 600 grams and not 400. All was not being assimilated. The motions were copious, and contained 35 per cent. of fat instead of 20; they were badly digested and sometimes also liquid. Thus, although taking less than the average, this infant was increasing greatly, for he was receiving a very rich milk.

The quantities have therefore only a relative value. If the milk be poor in butter, the infant may absorb a larger quantity without danger; if, on the contrary, it be rich in fat, the infant ought to take less, otherwise the excess appears in the stools, and troubles arise from the alimentary tract.

To put it briefly, you will give to an infant a quantity of milk, determined in accordance with its weight, but varying more or less in proportion to the richness of the milk in fat.

Here is an observation which emphasises the importance of the quality of the milk. An infant, No. 237, born on January 21, 1895, was received on February 16, 1895, weighing 1820 grams. At the beginning he had a very good wet-nurse, whom we shall call A, who was giving him only a little milk, between 400 and 500 grams per day; with her the infant's curve rose regularly. This

wet-nurse had to leave. She was replaced by another, B, from whom the infant drank greater quantities ; he was now absorbing 500–600 grams, 100 grams more than he had taken from A, and yet he was stationary. His curve formed a plateau during the whole of this period. A third wet-nurse, C, was given to him ; at first she gave the same quantity of milk as B, but the infant increased considerably once more (Fig. 18). Later, having a greater weight, he required more.

Here, then, was a healthy infant whose digestive tube was functioning well. He had three wet-nurses in succession ; his digestive tube remained unaltered. With the first, who had an excellent milk, he increased considerably ; with the second, although he took more, he remained stationary ; whilst with the third, although at the beginning he absorbed the same quantity as he did from the second, he had again a very fine curve. You see, therefore, the great importance of the quality of the milk.

Lastly, there is another matter to which I wish to refer. Infants are sometimes brought suffering from diarrhœa. These are little ones, already born some time, who have been badly fed. Some have taken too much, and others have absorbed cows' milk of bad quality, or injurious food preparations. They are often dangerously ill, and our first care is to put their alimentary canal in order.

On July 18, 1896, an infant, No. 193, was brought to us. It had been born on June 19. Its rectal temperature was 35° C., and its weight 2290 grams. It had diarrhœa and vomiting ; its stools were copious and green, and its buttocks erythematous. As may be seen on Fig. 19, the infant was put on a reduced diet ; albumen water and milk were given, and some intestinal antiseptics were prescribed. The diarrhœa with green stools persisted several days ; then the motions, still liquid, became more yellow. The infant continued to lose weight till August 5, and the quantity of milk taken was almost uniformly below normal. The motions became of good consistence. Assimilation was being properly performed once more ; and the infant, thus cured, began to increase in weight. The quantities of milk ingested soon rose to the average, and even surpassed a little the line corresponding to one-fifth of its body weight.

Here is another example : An infant, No. 215, born on July 13, 1897, was brought to the Maternité on August 28, weighing 2890 grams. It was not a weakling in the proper sense of the term ; it was not affected with congenital debility, but it was enfeebled from



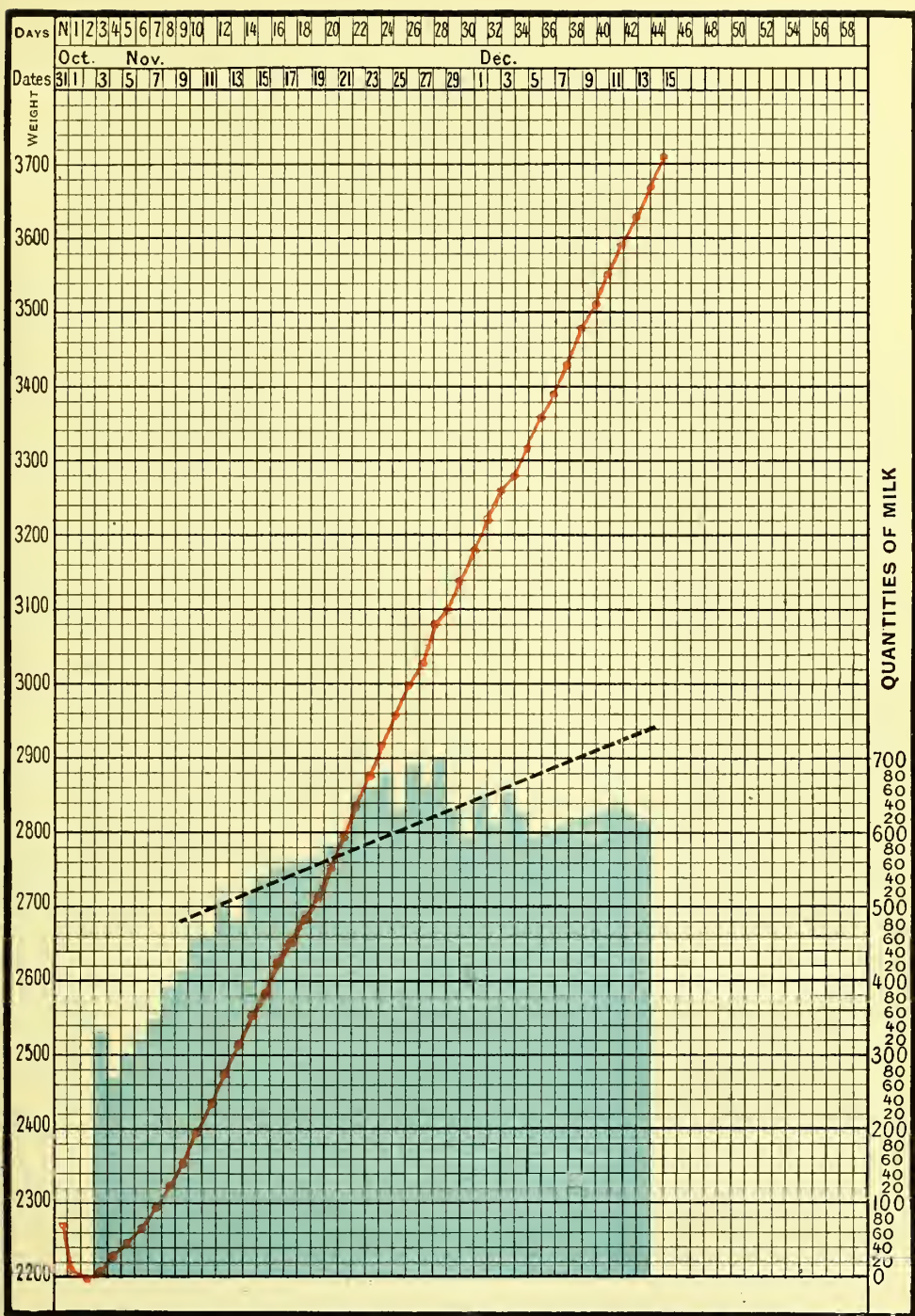


FIG. 17.—Weakling who, suckled by his wet-nurse after she had given the breast to her own infant, took a milk very rich in butter, and absorbed a quantity inferior to one-fifth of his body-weight. Blue columns represent the daily allowance of milk. The interrupted black line corresponds to one-fifth of the body-weight.





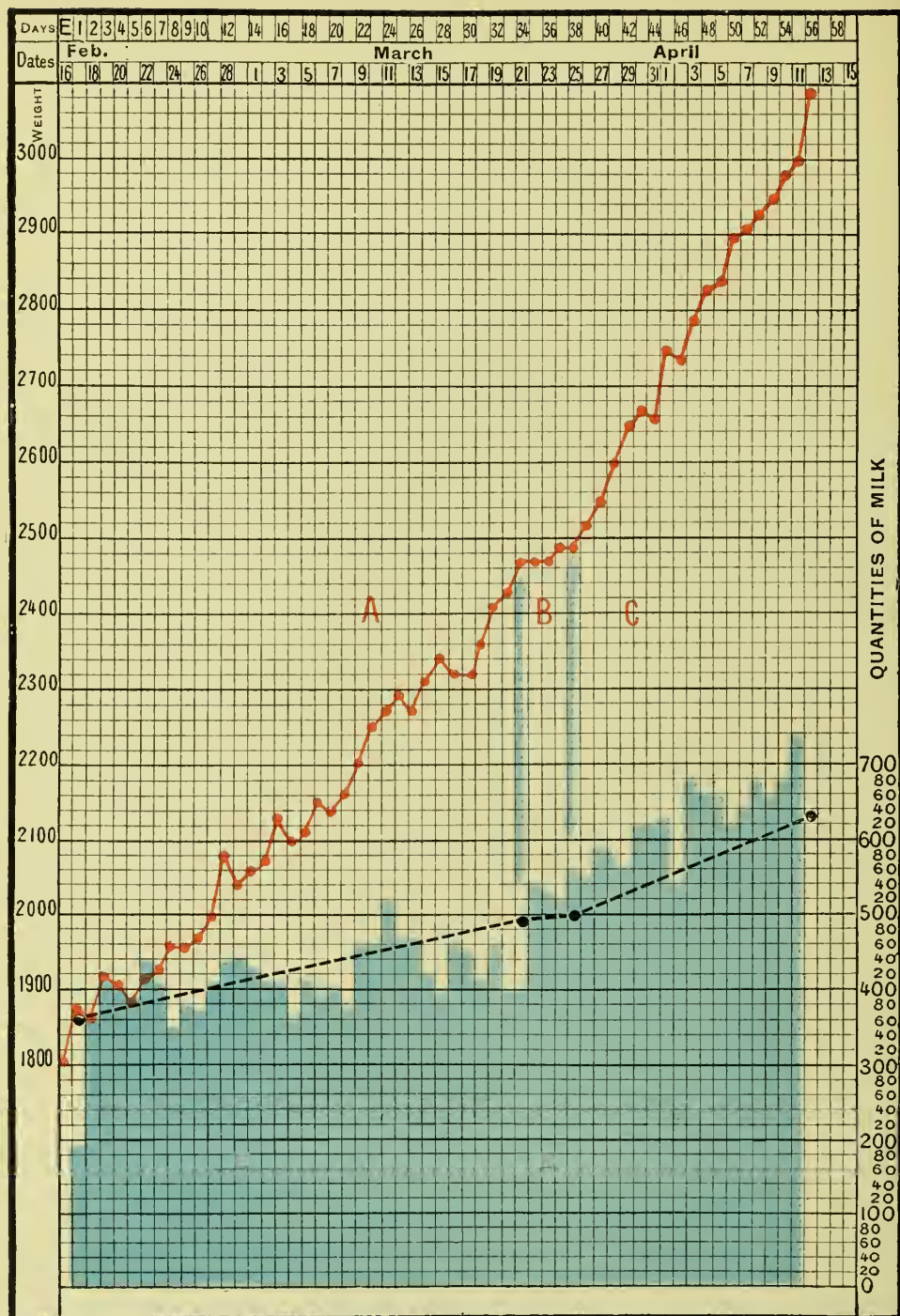


FIG. 18.—Weakling suckled successively by three wet-nurses, A, B, and C, the *quality* of whose milk differed. From the first, A, he took less, from the second, B, and from the third, C, more than the amount corresponding to one-fifth of his body-weight. With A his weight rapidly increased, with B it remained stationary, and with C it again increased. The blue columns indicate the quantities of milk taken per day. The black line corresponds to one-fifth of the infant's body-weight.



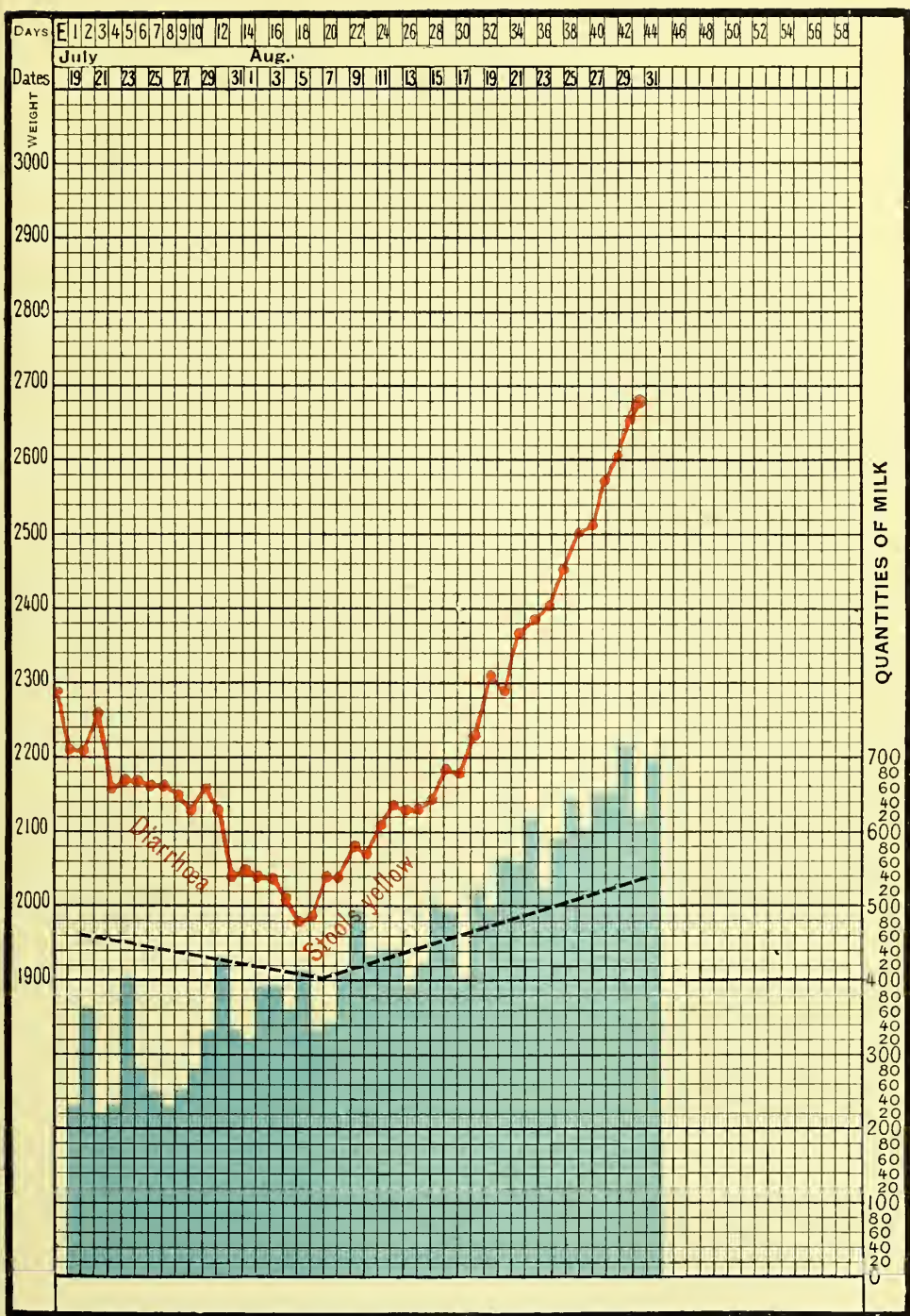


FIG. 19.—Weanling brought with diarrhoea. Treated by dieting. His weight began to increase as soon as the stools became yellow. He was then allowed to take the normal quantity, which corresponds to a little more than one-fifth of the body-weight.







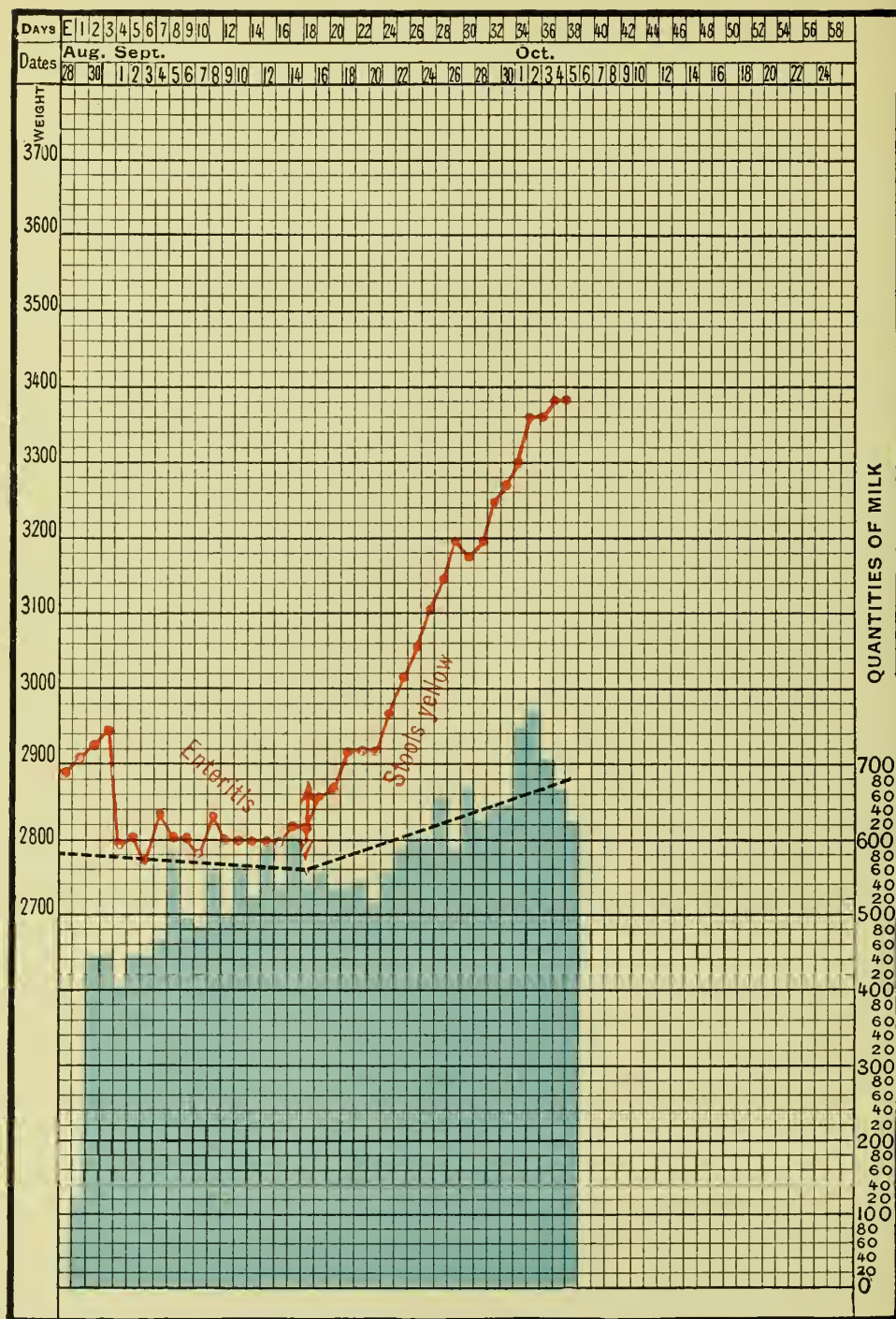


FIG. 20.—Enteritis. As soon as the stools became yellow the infant's weight began to increase.

an attack of enteritis. The stools were green, and for some days the temperature oscillated between  $39^{\circ}$  and  $40^{\circ}$  C. It was cared for, put on an appropriate diet, and at the end of eighteen days the stools became normal, and the infant began to increase in a regular and rapid manner. You see once more (Fig. 20) that the quantity of milk taken was below the average, for some days.

In these cases, therefore, it is essential, first and foremost, to cure the infants by suitable means, of which dieting is of prime importance. When the digestive tube has been completely restored to its normal condition, when the fever has disappeared, when the motions have become yellow and of the proper consistence, the infant begins to assimilate. It then increases in weight, and takes without inconvenience the quantities of milk which we have indicated as the average.

You see, gentlemen, the importance of the digestive tube in the premature infant. Excess and insufficiency in their feeding may give rise to fatal consequences. The quantity they absorb must be regulated. It varies with the age and weight. Immediately after birth the weakling takes very little, but the amount increases regularly till the tenth day. After that the basis for calculation is the weight. On an average a quantity slightly surpassing a fifth of the body weight will be adequate, but this figure is not absolute. It varies with the quality of the milk and the assimilative power of the weakling. If the alimentary canal be in an unhealthy condition, the first thing to do is to cure it, otherwise the infant cannot assimilate, and dies of inanition. You ought to warn the family that it is going to lose weight, but that when its motions become yellow it will increase again, and its curve will rise regularly.

These points being thoroughly settled, how ought we to direct the feeding of a congenitally feeble infant? How one can best avoid errors and have most chance of success, we shall study in our next lecture.

## LECTURE III

SUMMARY :—The feeding of weaklings—Human milk *the* food for infants—Composition of milk : butter, lactose, proteid, salts—Production of animal heat—Number of calories required by infants—Diet to maintain life—Diet to allow of growth.

Wet-nurses for weaklings—Fourteen feed fifty-four infants—Quantity of milk supplied by a good wet-nurse—Amount varies with the demand—Milk-producing capacity of women—Supply diminishes the less they suckle, and *vice versa*—Confirmatory observations—Quality of milk furnished in response to great demands.

Use of pepsin.

Artificially digested milk—Its advantages—Strike of wet-nurses at the Maternité—Value of her child to the wet-nurse of a weakling—Weaklings treated at the Maternité—Consequences—Mother desirous of nursing her weakling—How to aid her in hospital and in private practice.

GENTLEMEN,

In the previous lecture we were discussing the feeding of weaklings. I pointed out the importance of adjusting the quantity of milk absorbed, and I endeavoured to fix a basis upon which the requirements of an infant affected with congenital debility might be estimated.

Feeding is indispensable to the nutrition and development of tissues and the production of animal heat.

*The* food for infants is human milk ; it is, with certain exceptions, the only one which ought to be given to weaklings and newly-born children.

The average composition per litre of human milk is—

35 grams of butter.

74-75 grams of lactose or sugar of milk.

12-14 grams of proteids or albuminoids.

2 grams of mineral salts.

This makes a total of about 125 grams of solids.

Of all these substances the most important is butter. It is the main factor in the generation of animal heat, as it is the constituent in milk which furnishes the greatest number of calories. One gram of butter yields 9.3 calories, and 96 per cent. of the butter in milk is utilised by the organism.

If the number of calories representing the average alimentary



ration of an infant be calculated, it is found that 53 per cent., more than half, come from butter.

Butter, therefore, plays an important part in the feeding. An infant ought to take plenty of a milk poor in butter and less of one rich in it. I gave you examples of this in our last lecture, and I further showed that if the milk be too fat it may cause indigestion, and instead of the normal 4 per cent. of butter in the stools, as much as 30 or 35 per cent. may then be found.

Butter, although of great consequence as a heat producer, is not, however, the only nutritive substance contained in the mammary secretion. From a commercial point of view the greatest interest doubtless centres upon it. In cows' milk it is the constituent which has the highest marketable value, and therefore it is liable to be fraudulently removed. In milk, however, not only is there butter, there are in addition sugar and proteids. These also can be oxidised; and, as the sugar of milk furnishes 29 per cent. and the albuminoid substances 18 per cent. of the total calories, they have a considerable value in the production of animal heat.

These substances are destined not solely for the production of heat but also for the formation and renovation of the tissues. This applies particularly to the proteid matter and in a less degree to the mineral salts.

We must remember that in every litre of milk there are 875 grams of water. The presence of this water in milk explains what at first seems a singular phenomenon. Certain infants, just cured of diarrhoea, increase in one week by 400, 500, or even 600 grams in weight. This is certainly not due to 600 grams of new tissues having been formed in so short a time. An infant with diarrhoea rapidly diminishes in weight owing to the loss of the fluid part of its tissues. Once the diarrhoea is cured, this drain is rapidly recovered from by the absorption of water from the milk. Hence the great augmentation in weight. Water also favours the functions of certain organs, the kidneys, for example, and by evaporation it plays an important part in the regulation of temperature.

It seems to be proved that an infant requires 100 calories, per kilogram of body weight, every twenty-four hours. Thus, an infant of three kilos would need daily a quantity of nutritive material sufficient to produce 300 calories. With tiny infants this number is relatively greater. In proportion to their weight the surface of their body is larger, and they thus present a more extensive area from which heat may be dissipated.

Lastly, we must not forget, in studying the feeding of infants, that they require not merely to be maintained as if their weight remained stationary, but also to have a growing allowance to meet their daily development and increase. If an infant and an adult were fed exclusively on milk, the former would absorb, relatively to its weight, much more than the latter, as the one has generally only to sustain life, while the other has to provide for growth.

\* Milk, then, has to be given to a weakling in sufficient quantity in order to safeguard against inanition, cyanosis, and chilling. I have endeavoured to determine the approximate amount an infant must take to obviate these dangers without incurring the risks of overfeeding.

How are infants nourished in wards for weaklings such as those at the Maternité? They are brought from the midwifery wards of other hospitals, or from their homes, and have no longer their mothers to give them the breast. Their feeding is entrusted to wet-nurses, who should be allowed to keep their own infants, for if they suckled only puny little beings, who are sometimes scarcely able even to swallow, their milk would diminish and even disappear.

How many wet-nurses are required?

The wards are intended to receive 26 or 28 infants, but they are usually crowded. In 1895 more than 40 infants were being accommodated, while there was room for only 14 wet-nurses. How could 40 weaklings be fed by 14 women, each of whom was already suckling her own child? This problem, at first glance insoluble, can be solved.

At the beginning the infants of the wet-nurses were suckled by their mothers, and I left them at the breast exclusively for several weeks. Then I began to give them sterilised milk, which, as is seen by their tracings, they tolerated well.

Further, wet-nurses can supply much more milk than one might credit. Here is how I found this out.

When I returned from my holidays on October 1, 1895, I found 50 weaklings in the cradles and incubators. To provide for their nourishment there were only 14 wet-nurses, and they had, in addition, to feed their own babies.

These 14 wet-nurses had to attend to  $50 + 14 = 64$  infants; each of them, consequently, had to suckle and tend either 4 or 5 ( $64 \div 14 = 4.5$ ). Each woman giving the breast about nine times to each infant had thus to furnish, on an average, 40 feeds per day. This, however, is not quite correct, for their own infants

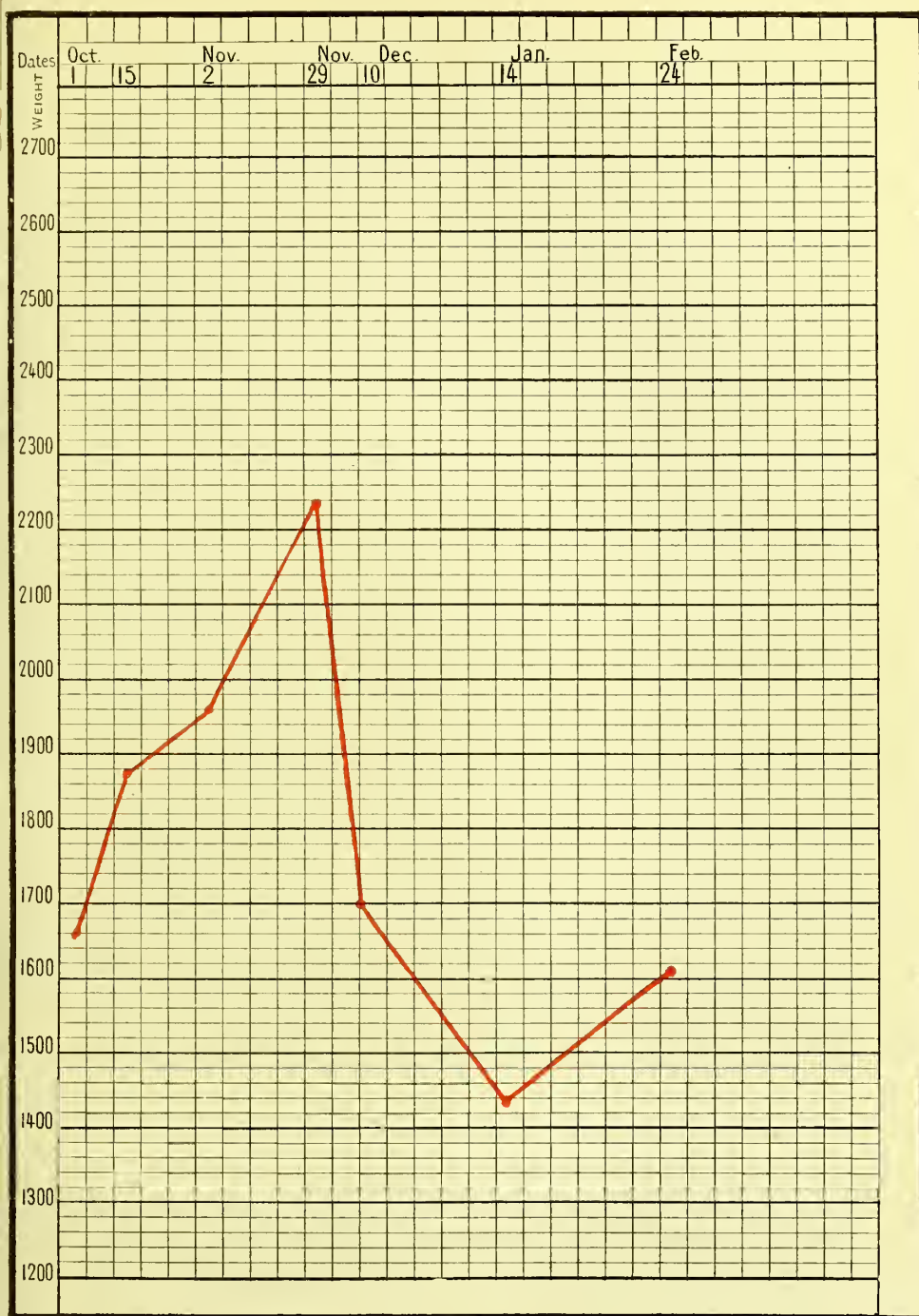


FIG. 21.—Average quantities of milk yielded by each of seven wet-nurses from October 1, 1895, to the end of February 1896.



were made to take sterilised milk. On the other hand, they were obliged to draw off their milk to feed those infants who could not suck, or who were suspected of syphilis, and were fed by hand. Further, they had to wash, bath, and dress their charges, change the hot water in the incubators, keep their own dormitory and dining-room in order, &c. Under these conditions the 14 wet-nurses were jaded and worn out—the nurslings entrusted to them scarcely increased in weight, and their own babies did not thrive.

I therefore reduced the number of weaklings from 50 to 40 by not replacing those who left or died. Our 14 wet-nurses had still to care for  $40 + 14 = 54$  infants, almost 4 infants (3.8) each, but they had now to give not more than 34 feeds per day, instead of 40.

Thenceforth the infants of the wet-nurses improved, and the weaklings steadily increased in weight.

Every fortnight the amount of milk given by our wet-nurses was estimated. This was easily done. As you know, each weakling is weighed before and after meals, and at the end of the day the quantity it has ingested is thus readily estimated. If we added together the quantities of milk which the wet-nurse had furnished to those she suckled, those who had to be gavaged and fed by hand, and her own infant, we could obtain her total milk production in the twenty-four hours.

In the table which I now show you I have placed the quantities of milk furnished by the seven wet-nurses who were in our service at the end of February 1896, and had been with us from October 1, 1895.

According to these figures the milk yielded by them increased in amount from October 1 to November 29.

Their total production on October 1 was 11,605 grams, an average of 1657 grams per wet-nurse. On November 29 it reached 15,620 grams, an average of 2230 grams per wet-nurse.

Names.	Oct. 1.	Oct. 15.	Nov. 2.	Nov. 29.	Dec. 10.	Jan. 14.	Jan. 24.
Larth . . .	1,340	1,340	970	1,545	1,070	1,240	1,420
Bony . . .	1,590	1,800	1,955	2,210	1,880	1,500	1,590
Elra . . .	2,000	2,040	2,330	2,320	1,880	1,470	1,590
Pect . . .	1,400	1,990	2,340	2,545	1,800	1,650	1,670
Lequill . .	1,895	2,070	2,170	2,840	2,010	1,240	2,030
Adam . . .	1,660	2,090	2,120	2,350	1,670	1,540	1,485
Thiel . . .	1,720	1,750	1,780	1,810	1,530	1,420	1,500
Total . .	11,605	13,080	13,665	15,620	11,840	10,120	11,285
Average .	1,657	1,868	1,952	2,230	1,690	1,431	1,612



This remarkable increase in the milk secretion of these wet-nurses is graphically represented on the curve (Fig. 21).

Here, then, are women who became capable of furnishing 2230 grams of milk per day. It must not be thought that the average is based on insufficient data, as it is founded upon statistics relating to seven wet-nurses, one of whom, indeed, yielded as much as 2840 grams per twenty-four hours.

What happened then? On November 26, at 5 P.M., the wet-nurses, in spite of our remonstrances, went out with their infants in cold and rain. Next day, three of them and nine of their little ones had bronchitis. On making my customary visit to the weaklings that morning I found some of them had not increased, and on seeking the cause I discovered that the wet-nurses, to whom they were entrusted, had been up all night attending to their own babies.

On December 3, in spite of all our precautions, the epidemic spread to the weaklings, a great number of whom died. We did not admit others.

The quantity of milk given by the wet-nurses was then seen to diminish.

On December 10, it was not more than 11,840 grams for the seven, which was an average of 1690 grams per woman.

On January 14, the total yield was only 10,020 grams, an average of 1431 grams each.

The extremes were—

11,605 grams,	October 1,	1657 grams per wet-nurse.
15,610 "	November 29,	2270 " "
10,020 "	January 14,	1431 " "

Between November 29, maximum figure, 15,620 grams, and January 14, minimum figure, 10,020 grams, the production had decreased more than one-third.

The wards were reopened for the reception of new cases on February 1, 1896. A greater quantity of milk then became necessary, and the yield was seen to increase. On February 24, it attained 11,285 grams for the seven, being an average of 1612 grams each.

Below, we have tabulated the observations of the milk production of three wet-nurses, who were not in our service on

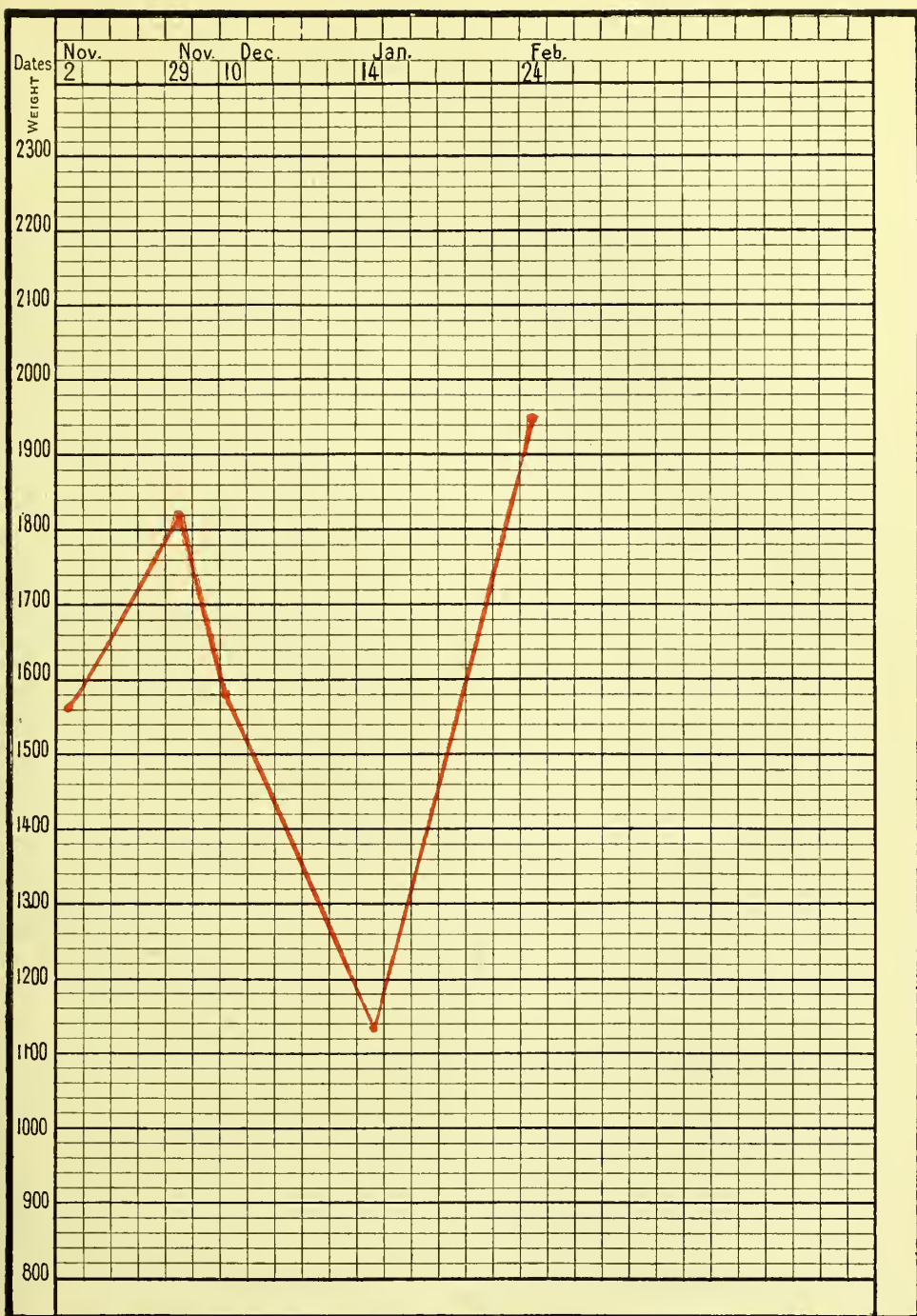


FIG. 22.—Average quantities of milk furnished by each of three wet-nurses from November 2, 1895, to the end of February 1896.



October 1, but who entered it, one on October 3, and two on October 28.

Names.	Nov. 2.	Nov. 29.	Dec. 10.	Jan. 14.	Feb. 24.
Leje . .	1535	2140	1660	1030	2240
Menet . .	1560	1520	1480	990	1780
Mang . .	1610	1810	1650	1400	1850
Total . .	4705	5470	4790	3620	5870
Average .	1568	1823	1596	1140	1956

The curve which represents these figures also rises till November 29 (Fig. 22).

From the outbreak of the epidemic the quantity of milk required gradually diminished.

When the wards were reopened, and infants again received, a greater amount of milk was needed; the production, which from 1823 grams per day had fallen to 1140 grams, a diminution of more than one-third, then rose to 1956 grams.

The average quantity of milk daily furnished by these wet-nurses will appear to you considerable. It was a source of wonder to us also. These women did not receive any particular or extraordinary diet. They were excellent wet-nurses, for they gave on an average 1657, 1868, 1953, and even up to 2270 grams of milk, per day. Evidently, they were stimulated to supply plenty of milk through plenty being demanded from them.

With a view to studying this matter more closely, I tried to trace what had occurred from the day these wet-nurses first entered our service.

Since the quantity of milk taken by the weaklings they suckled was known at the end of each day, it was only necessary to weigh their own babies, before and after their breast feeds, in order to obtain the total milk production in the twenty-four hours. It was found that the quantity continued steadily to increase during a certain time.

The wet-nurse Ga——, for example, who was delivered on

July 16, 1896, and entered the department for weaklings on August 4, gave (Fig. 23)—

On August 6 . . . .	490 grams of milk.
„ September 7 . . . .	910 „
„ September 23 . . . .	1450 „
„ October 20 . . . .	1640 „
„ November 16 . . . .	1900 „

The wet-nurse Be——, who also was delivered on July 16, 1896, entered the department on August 4 ; she furnished (Fig. 24)—

On August 6 . . . .	410 grams of milk.
„ September 23 . . . .	1370 „
„ October 20 . . . .	1410 „
„ November 16 . . . .	2050 „

The more these wet-nurses suckled the greater the quantity of milk they yielded, so that the production ultimately attained considerable dimensions.

Very much interested, I continued my researches. I compared the quantities of milk which they furnished from day to day, when the number of infants was constant, and when it varied.

The wet-nurse Den——, delivered on May 10, 1897, entered the department on June 5 (Fig. 25). Three tiny infants were confided to her care. Including her own baby, she had then four nurslings.

From June 5 to 6 she gave 550 grams of milk in 24 hours.

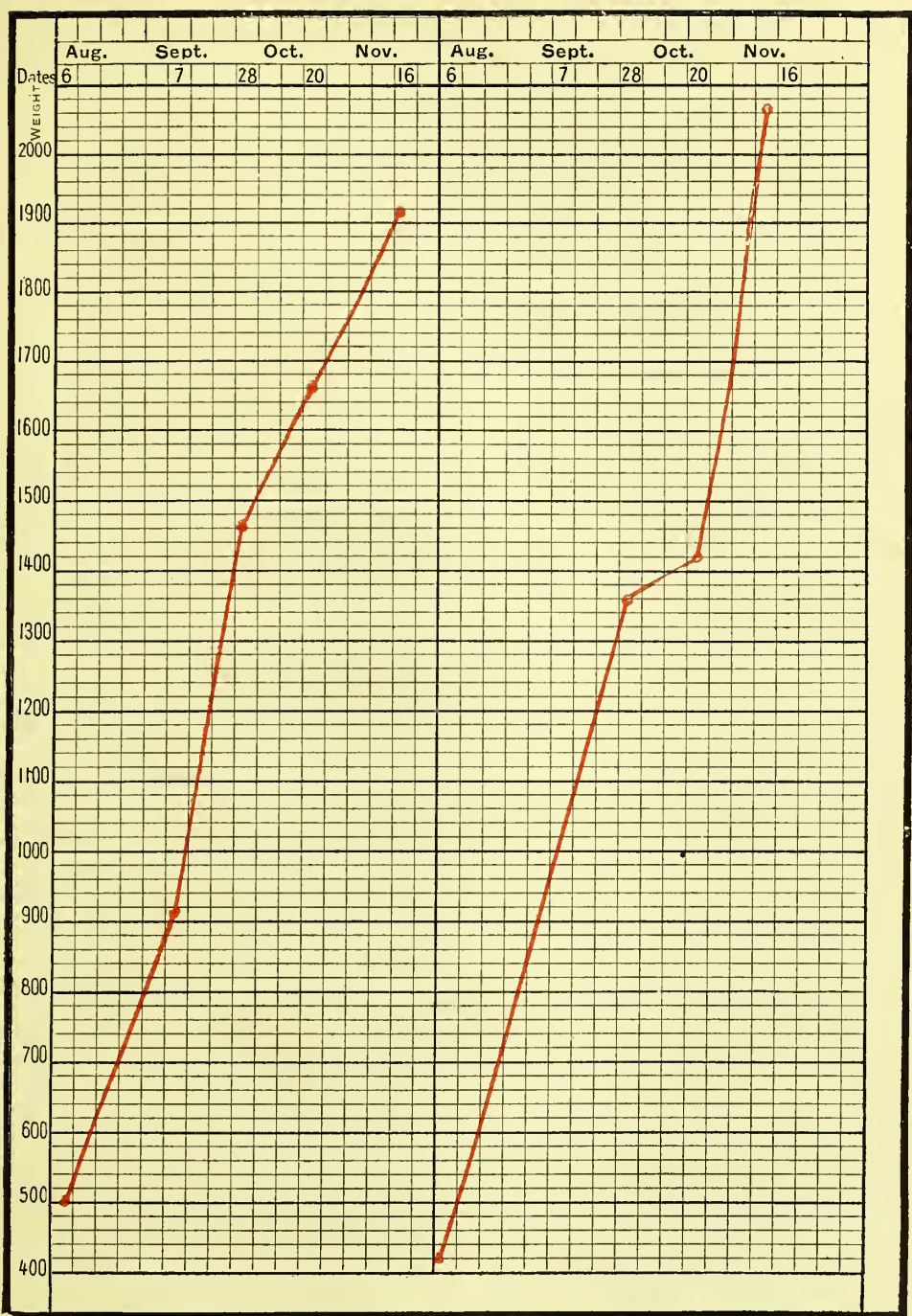
„ „ 6 to 7 „	1040 „ „ „
„ „ 7 to 8 „	1360 „ „ „
„ „ 8 to 9 „	1300 „ „ „
„ „ 9 to 10 „	1700 „ „ „
„ „ 12 to 13 „	1760 „ „ „

The infant of the wet-nurse sucked greedily. It had some digestive disturbance and diarrhœa, so its allowance was diminished for some days.

From June 13 to 14 the wet-nurse gave 1630 grams of milk.

„ „ 14 to 15 „	1470 „
„ „ 15 to 16 „	1420 „
„ „ 17 to 18 „	1580 „





FIGS. 23 and 24.—Fig. 23, on the left, and Fig. 24, on the right, show how the milk production of two wet-nurses increased.





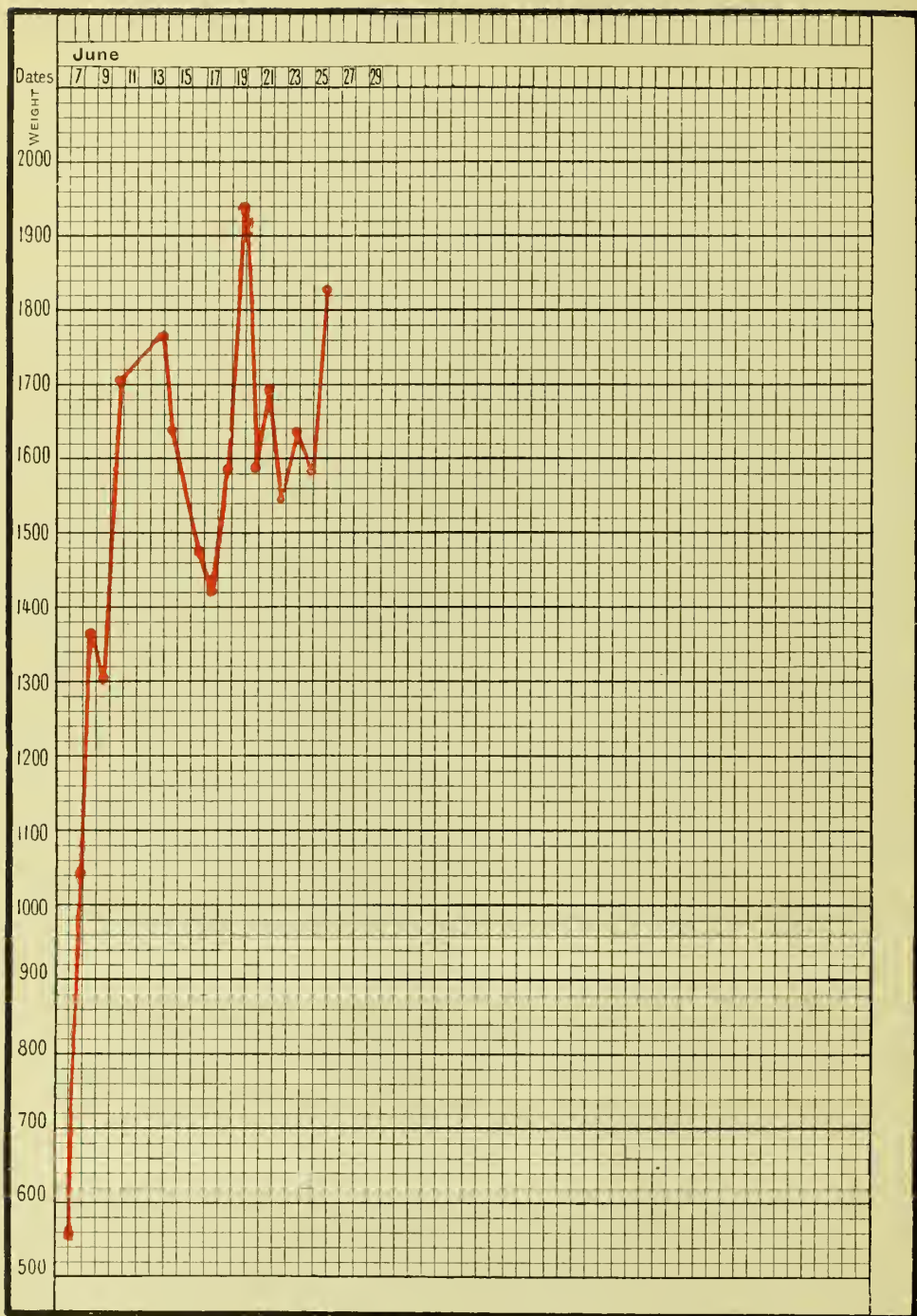


FIG. 25.—The milk production of a wet-nurse varies with the demands of her nurslings.

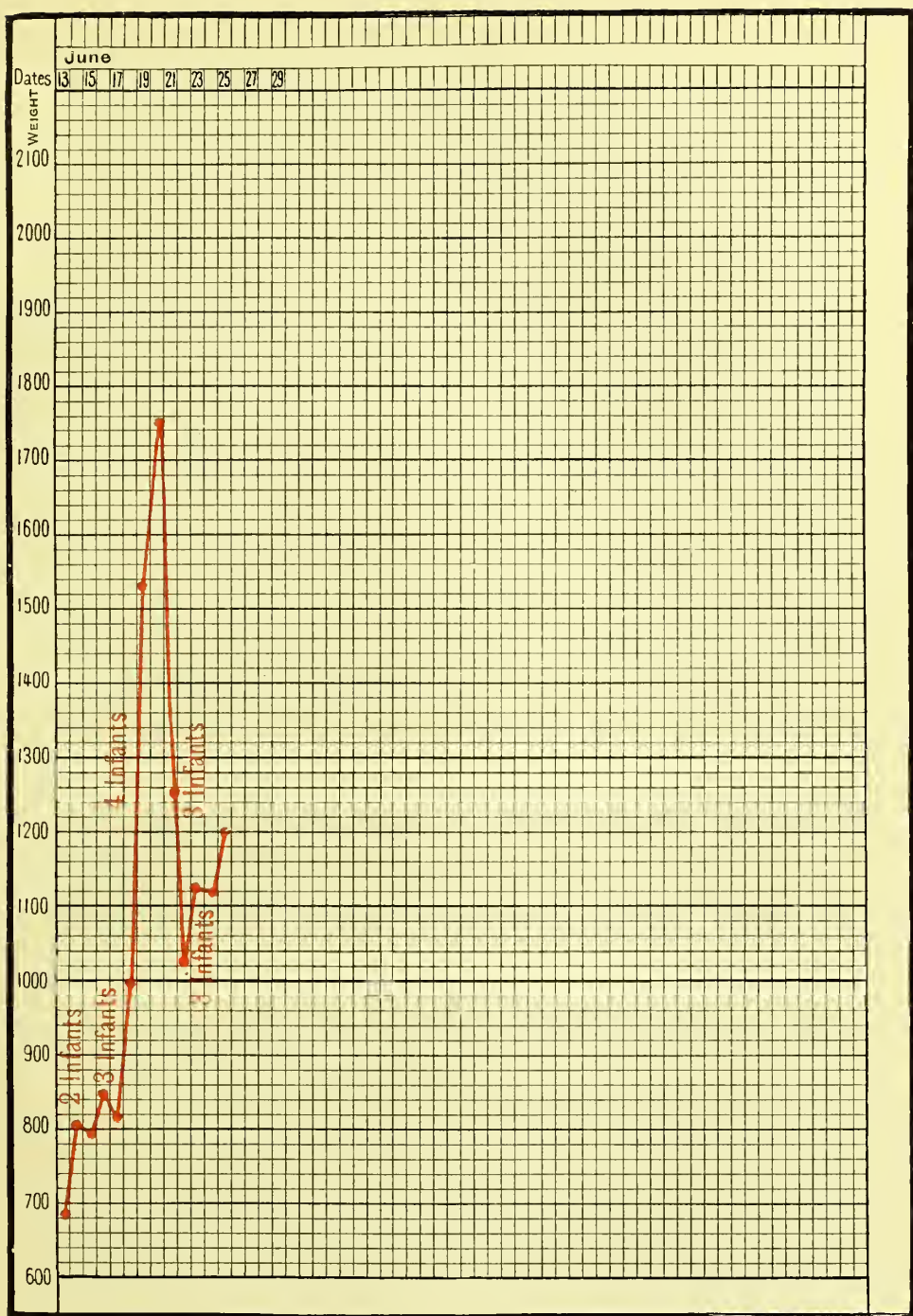


FIG. 26.—The milk production of a wet-nurse varies according to the number and the needs of her nurslings.







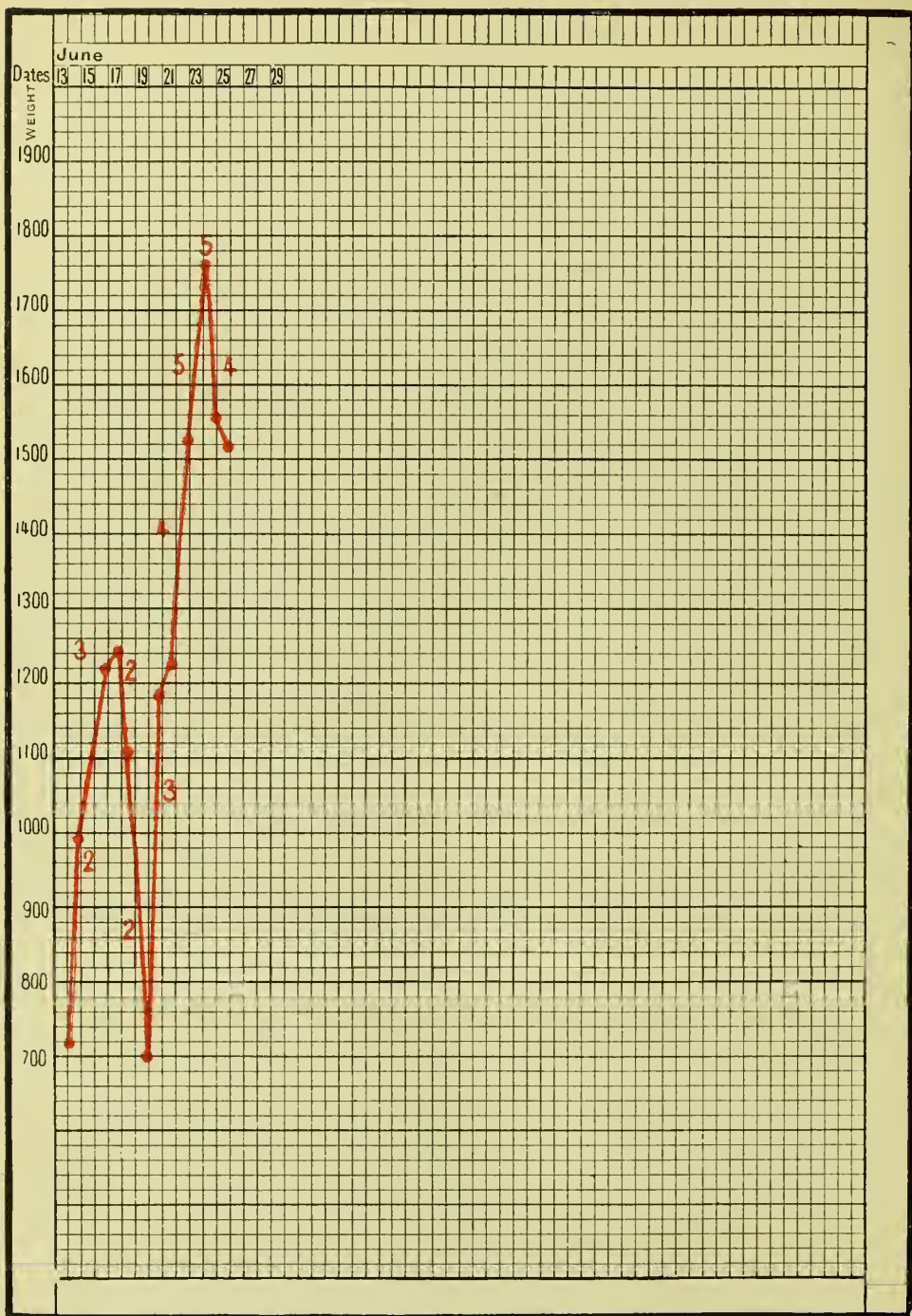


FIG. 27.—The milk production of a wet-nurse varies according to the number and the needs of her nurslings.

From the 18th to the 19th she let her infant take a great deal (740 grams), so that she furnished—

From June 18 to 19	.	.	.	1930	grams of milk.
" "	19 to 20	.	.	1580	"
" "	20 to 21	.	.	1690	"
" "	21 to 22	.	.	1540	"
" "	22 to 23	.	.	1630	"
" "	23 to 24	.	.	1589	"
" "	24 to 25	.	.	1820	"

During this period this woman constantly suckled four infants ; the quantity of her milk increased rapidly from 550 to 1760 to 1930 grams, and it varied according to the demands of the nurslings ; the day on which she furnished most (1930 grams), her own infant for his share alone took 740 grams.

Here is another observation in which the number of infants suckled was made to vary.

The wet-nurse, Mart——, delivered May 25, 1897, entered the department on June 11. Including her own baby, she nursed successively two infants, then three, then four, and then three again.

From June 12 to 13 she gave 690 grams for 2 infants.

" "	13 to 14	"	810	"	2	"
" "	14 to 15	"	800	"	2	"
" "	15 to 16	"	850	"	2	"
" "	16 to 17	"	820	"	2	"
" "	17 to 18	"	1000	"	3	"
" "	18 to 19	"	1530	"	4	"
" "	19 to 20	"	1750	"	4	"
" "	20 to 21	"	1260	"	3	"
" "	21 to 22	"	1030	"	3	"

One of the infants was taking 470 grams per day ; it was replaced by a smaller, which drank only 180 grams. She then yielded—

From June 22 to 23	.	.	.	1130	grams for 3 infants.
" "	23 to 24	.	.	1120	" "
" "	24 to 25	.	.	1200	" "

In proportion as the demand was greater the woman supplied more milk ; as the demand decreased so also did the amount of milk produced (Fig. 26).

## THE NURSLING

Here is another observation which is no less convincing.

The wet-nurse Al——, delivered May 25, 1897, entered the department on June 11 (Fig. 27).

From June 12 to 13 she gave 720 grams of milk to 2 infants.

"	"	13 to 14	"	990	"	"	3	"
"	"	15 to 16	"	1210	"	"	3	"
"	"	16 to 17	"	1240	"	"	3	"
"	"	17 to 18	"	1100	"	"	2	"

But her own infant had taken the enormous quantity of 810 grams ; it had some digestive trouble, and its ration had to be diminished (see Appendix).

From June 18 to 19 she gave 700 grams of milk for two infants. Her infant this day was ordered only 360 grams of milk.

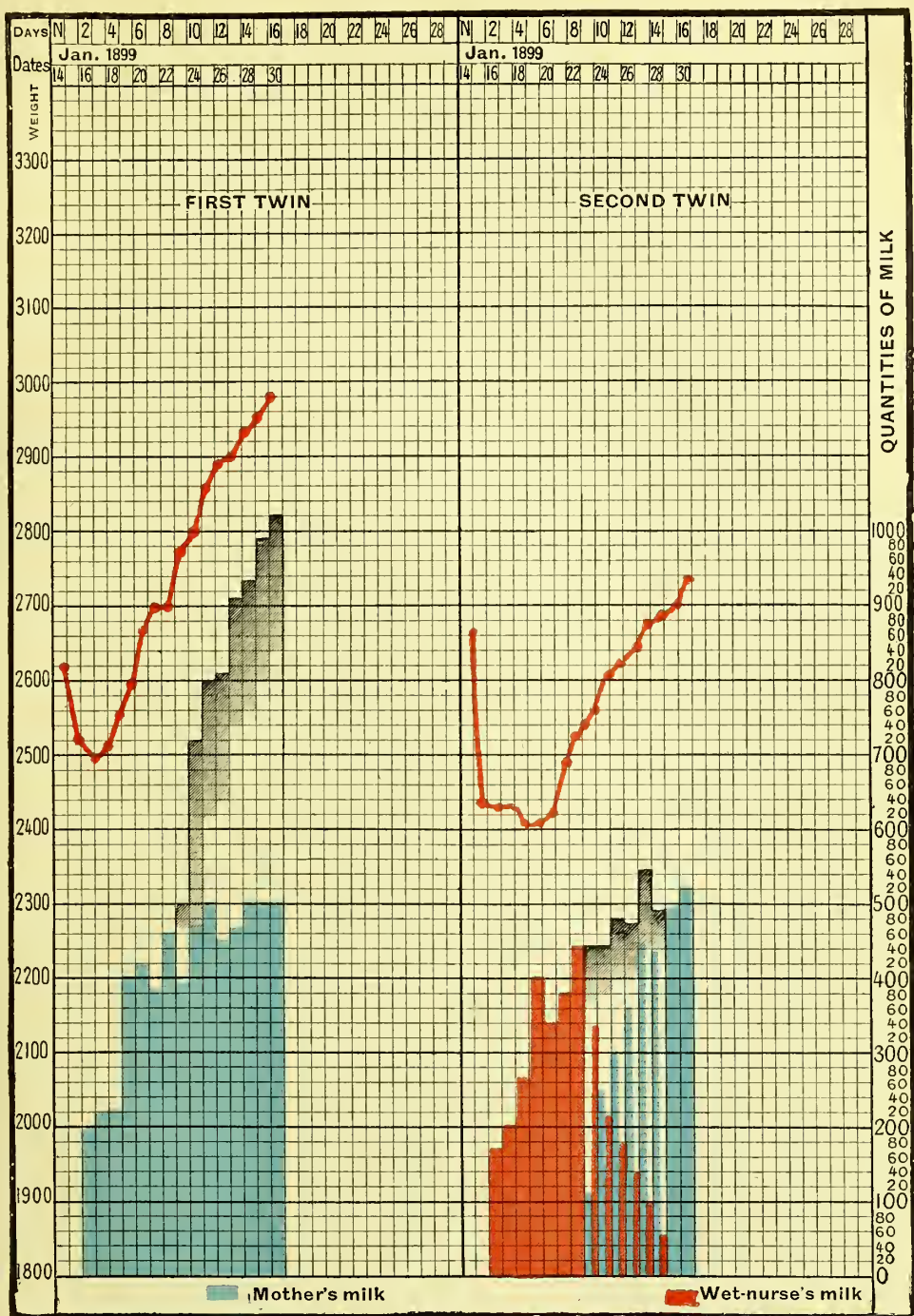
From June 19 to 20 she gave 1180 grams for 3 infants.

"	"	20 to 21	"	1220	"	"
"	"	21 to 22	"	1520	"	"
"	"	22 to 23	"	1750	"	"
"	"	23 to 24	"	1550	"	"
"	"	24 to 25	"	1510	"	"

It is thus clearly demonstrated that the quantity of milk increases with the demand, and diminishes as the nurslings need less, or are less numerous.

You were able to follow in the wards, a short time ago, an observation of the same kind, in which I predicted to you the result (Fig. 28). A spare, feeble, miserable-looking little woman had given birth to twins on January 14 last. She nourished one of them, called René. He weighed at birth 2630 grams, decreased to 2500, and then had a curve which rose regularly and rapidly, so that on January 30 he was 2980 grams ; when put to the breast he took 500 grams. The other infant, named Robert, who weighed at birth 2660 grams, was at first entrusted to a wet-nurse ; he fell to 2400 grams, and then began to increase. The mother wished to suckle only one of the twins, but what would have become of the other when she left hospital ? Whilst leaving it to be nourished mainly by the wet-nurse, we began soon to put it to the mother's breast also. On January 23 it took from its mother 110 grams of milk ; then 250, 300, 360, 440, 490, and ultimately 520 grams, the total amount which it required. Of course, during this time it was getting steadily less and less from the wet-nurse, until finally she altogether ceased to suckle it. On the day of its departure it weighed 2725 grams.









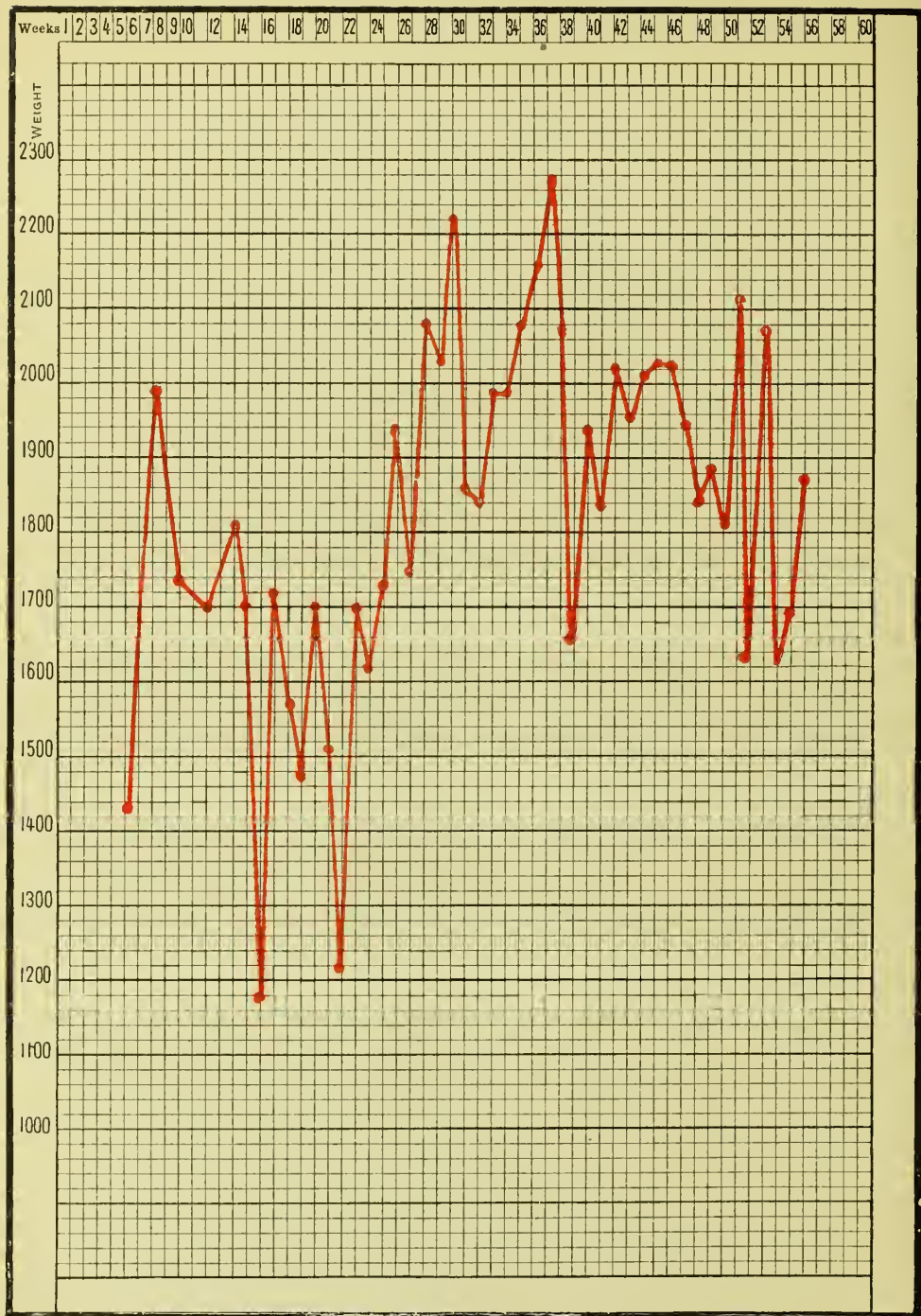


FIG. 29.—Average daily quantities of milk furnished by the wet-nurse Andr— from the sixth to the fifty-sixth week.





FIG. 30.—Average daily quantities of milk furnished by the wet-nurse Gail— from the eighth to the fiftieth week.







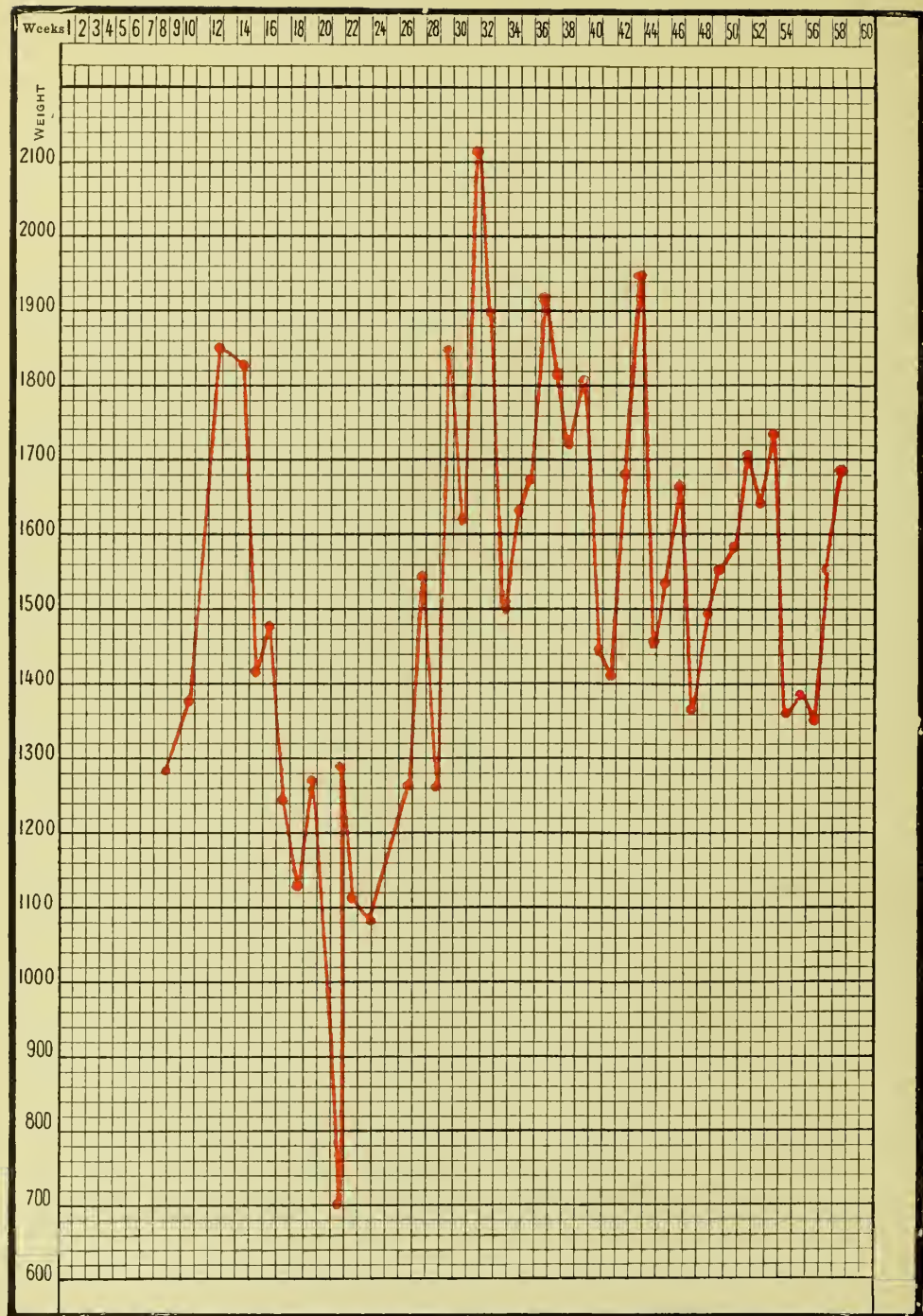


FIG. 31.—Average daily quantities of milk furnished by the wet-nurse Capit— from the eighth to the fifty-eighth week.

The tiny mother, in spite of her poor appearance, was able to nurse both her infants, and she continued to suckle them after her return home. Her milk supply increased progressively with the demand, and she, alone, was producing 1020 grams per day.

Fig. 28 enables you to follow the development of the mammary secretion in this woman from delivery. The milk furnished by the mother is represented in blue, that by the wet-nurse in red. The tracing in black which accompanies the curve of the first twin, René, shows the total quantity of milk furnished by the mother; that on the curve of the second twin, Robert, represents the total quantity of milk taken by him from wet-nurse and mother.

I have just shown you that certain wet-nurses yield considerable quantities of milk. But how long does this last? With some women it continues a very long time. Here is, for example, the curve of a wet-nurse, Aud——, aged 19, who was delivered on November 14, 1896. She entered the department on December 13 of the same year (Fig. 29). From December 29 to 30 she yielded 1459 grams, and from January 15 to 16, in her eighth week, 1990 grams of milk. The amount secreted varied with the nurslings' needs; it fell as low as 1120 grams; it rose to 2080 grams in the twenty-eighth week; 2235 grams in the thirtieth; and 2280 in the thirty-seventh; she continued to furnish about 2000 grams per day, and at the fifty-sixth week was still supplying 1880 grams.

Here is another example. The wet-nurse Gaill——, confined on July 16, 1896, entered the department on August 4, 1896 (Fig. 30). From September 7 to 8 she gave 910 grams. The quantity rose to 1900 grams, and then oscillated and diminished, for there were not many infants to be fed; the admissions had had to be stopped because of epidemics of influenzal bronchitis which had taken place in January and April 1897. At the forty-ninth week, however, this woman was still furnishing 1720 grams of milk.

I could cite to you a number of similar observations, but I am afraid of abusing your patience. So I shall recount only one more, that of the wet-nurse Cap——, delivered on November 11, 1896. She came to the hospital on December 16 of the same year. From December 29 to 30 she gave 110 grams of milk; from January 15 to 16, 1280 grams (the curve begins from this date—Fig. 31); from February 5 to 6, 1380 grams; and from

February 22 to 23, 1850 grams. During the subsequent weeks the quantity grew steadily less and less, till she furnished only 710 grams in the twenty-four hours from April 28 to 29. As in the preceding case, the demand had decreased on account of the epidemics of influenzal bronchitis, which had emptied the wards. Later, the admission of new cases necessitated an increased supply, and, as you see from the curve, the amount of milk secreted became greater in response. On the twenty-sixth week it rose to 1275 grams; the twenty-seventh, to 1545 grams; the twenty-ninth, to 1850 grams; the thirty-first, to 2120 grams, &c. The production fluctuated between 1400 and 2000 grams, and at the fifty-eighth week this woman was still yielding 1690 grams of milk (see Appendix).

Evidently, these were exceptionally good wet-nurses, and it is precisely for this reason we employed them. One could hardly expect to find that all women were capable of furnishing such quantities of milk for such a length of time.

What was the quality of the milk produced in such abundance? It was not overcharged with butter, yet careful and repeated analyses showed that it was an excellent milk, containing on an average 35 grams of butter per litre.

Finally, it may be asked, How was the child of the wet-nurse affected, seeing that its mother had also to rear two or three weaklings?

The children of the wet-nurses were well supervised; they were weighed every week, and curves of their weights were kept. These curves are very satisfactory—at least equal and often superior to the normal. We had recourse in their case to *mixed feeding*. Several weeks after their entry, when we had made sure that they were digesting well and steadily increasing in weight, we gave them pure sterilised milk to the extent of at first 100 grams per day, and later, 200, 300, 400, 500, &c. The amount of milk which they obtained from their mother was correspondingly reduced to 400, 300, or 200 grams, and the rest of her supply was left for the benefit of the weaklings entrusted to her care.

It is not sufficient to provide wet-nurses to suckle infants, if the infants do not assimilate the milk. Do not forget that you are dealing with weaklings, in whom the incompletely developed organs seem to be unable to furnish all the elements necessary to the full utilisation of the milk. In some prematurely born infants digestion is only imperfectly performed, doubtless because the stomach,



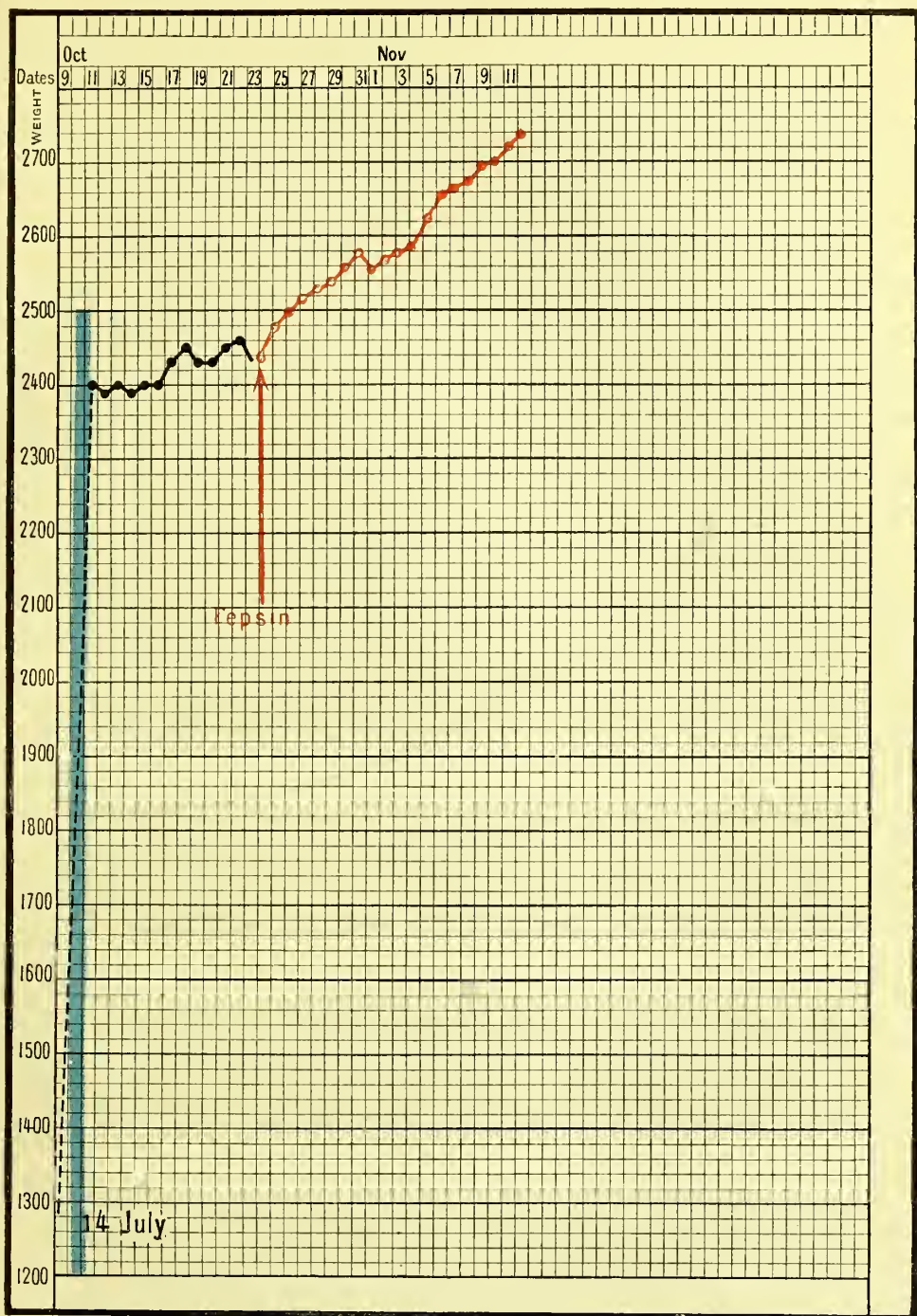


FIG. 32.--Weanling whose weight was almost stationary. Pepsin was given and his curve rose.





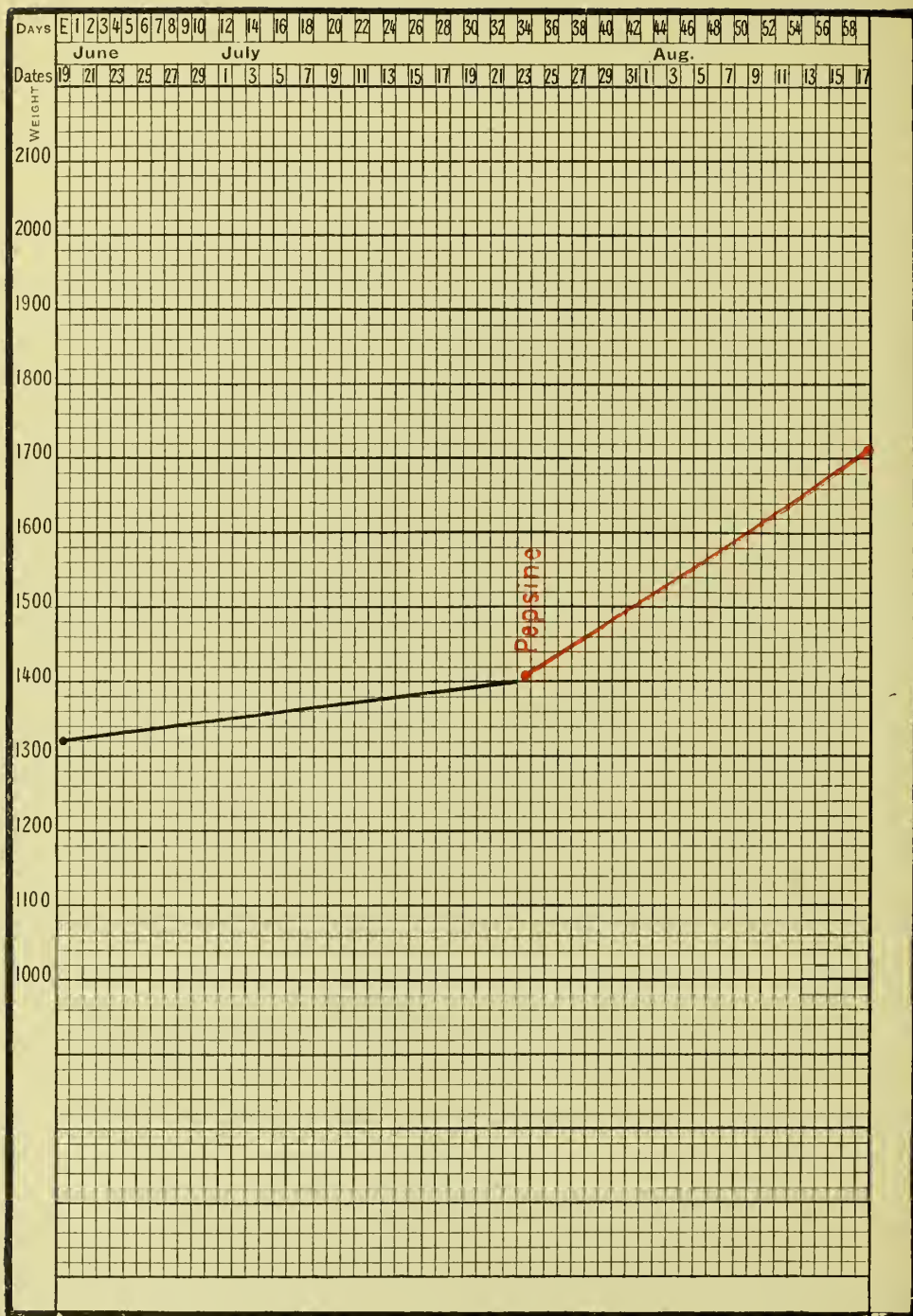


FIG. 33.—Weakling whose weight was almost stationary. Pepsin was given and his curve rose (only general outline of curve shown).

pancreas, &c., are not yet producing their normal secretions. For this reason some infants do not thrive.

I wondered if digestion could not be aided, so I gave pepsin to infants who were making no progress. In a great number of cases an immediate improvement was observed.

Fig. 32 is part of the curve of an infant born on July 7, 1895, and brought to the Maternité on July 14 (No. 253); it weighed 1300 grams. It felt absolutely cold, and the rectal temperature was found to be only  $31^{\circ}\text{C}$ . For some time its weight increased regularly; it reached 2400 grams, and then remained almost stationary, increasing only 30 grams in twelve days. Pepsin was administered, and the curve immediately recommenced to rise. The infant left hospital in splendid health, weighing 2760 grams.

Here is another example. An infant, born on June 18, 1895, was brought next day to the hospital (No. 213). It weighed, on arrival, 1320 grams, and its rectal temperature was  $35.4^{\circ}\text{C}$ . It augmented very little, so that at the end of a month and three days it had gained but 75 grams. Pepsin was given, and under its influence the curve began to ascend (Fig. 33).

I could enumerate a certain number of similar observations, but I shall confine myself to calling your attention to one more, which you yourselves were able to follow in the Clinique here. The infant (No. 1528) was born on November 7, 1898. The membranes ruptured three days before birth; the liquor amnii was foetid, and the infant had conjunctivitis and corneal opacity in both eyes. It weighed, at birth, 1625 grams; diminished to 1450 grams (Fig. 34); and then remained almost stationary. On November 25 it only weighed 1610 grams; then we began to give pepsin. Its curve at once commenced to rise steadily, although, as is seen from the blue columns placed at the bottom of the figure, the amount of milk furnished to it by the wet-nurse remained absolutely the same. We shall have to return to this case later, as it is interesting from other points of view.

For certain infants who do not assimilate well, we can, therefore, with advantage have recourse to pepsin; personally, I use it in the form of fine scales, of which I dissolve a small quantity in a little water, a pinch to a salt-spoonful, for example, and administer it before each meal.

As I have just said, there are infants who do not seem to have their alimentary apparatus sufficiently developed to enable them thoroughly to digest human milk. Since 1887 I have tried to



find if it were possible to combine in the proper analytical proportions the elements of a diet truly assimilable, and then, the deficiency being known, to add some substance capable of supplementing the insufficient glandular secretion. Several years ago it was sought to modify cows' milk by withdrawing from it part of the casein in order to make a "humanised milk," which would be more easily absorbed by infants. This was not quite what I was aiming at. I wished to digest cows' milk almost completely, and to give the product to infants as an adjunct to the nurse's milk, if that was not being properly utilised, so that the nutritive substances could be assimilated immediately, or after a very short digestive process. By means of macerations of calves' pancreas, M. Michel, the head of our laboratory, obtained the partial digestion of cows' milk in such a way as to modify especially the proteids, changing them into albumoses and peptones.

By experiments on young animals we then convinced ourselves that cows' milk thus modified had lost none of its qualities as a food specially adapted for rearing the young.

The figure I show you (Fig. 35A) is the curve of a dog which, from the twelfth day of its life, received this digested cows' milk, corrected by the addition of water and sugar, the same preparation which was subsequently administered to weaklings.

On comparing the composition of this product with that of bitches' milk, so rich in mineral substances, especially phosphates, one would be inclined to think that it was scarcely suitable for the nutrition of a young dog. Judged by the curve, however, the animal adapted itself exceedingly well to this diet. The digested milk was put in a bottle which was provided with a teat, and it was most amusing to see the tiny dog, held in the arms of the laboratory boy, trying to seize the neck of the bottle between its forepaws and sucking with extraordinary avidity. To begin with, it received, daily, 250 grams of digested milk, then 275, 300, 350, and so on, up to 600 grams.

On two occasions it was given two feeds less in the twenty-four hours: from November 27 to 28 it got only 250 grams of milk instead of 350 grams, the quantity absorbed on the previous and following days: it increased only 5 grams, and its curve presented a plateau. Similarly, from December 5 to 6 it received 300 grams instead of 400, the quantity ingested on the preceding and subsequent days: again the augmentation was only 5 grams, and the curve showed another plateau. On November 19 the dog

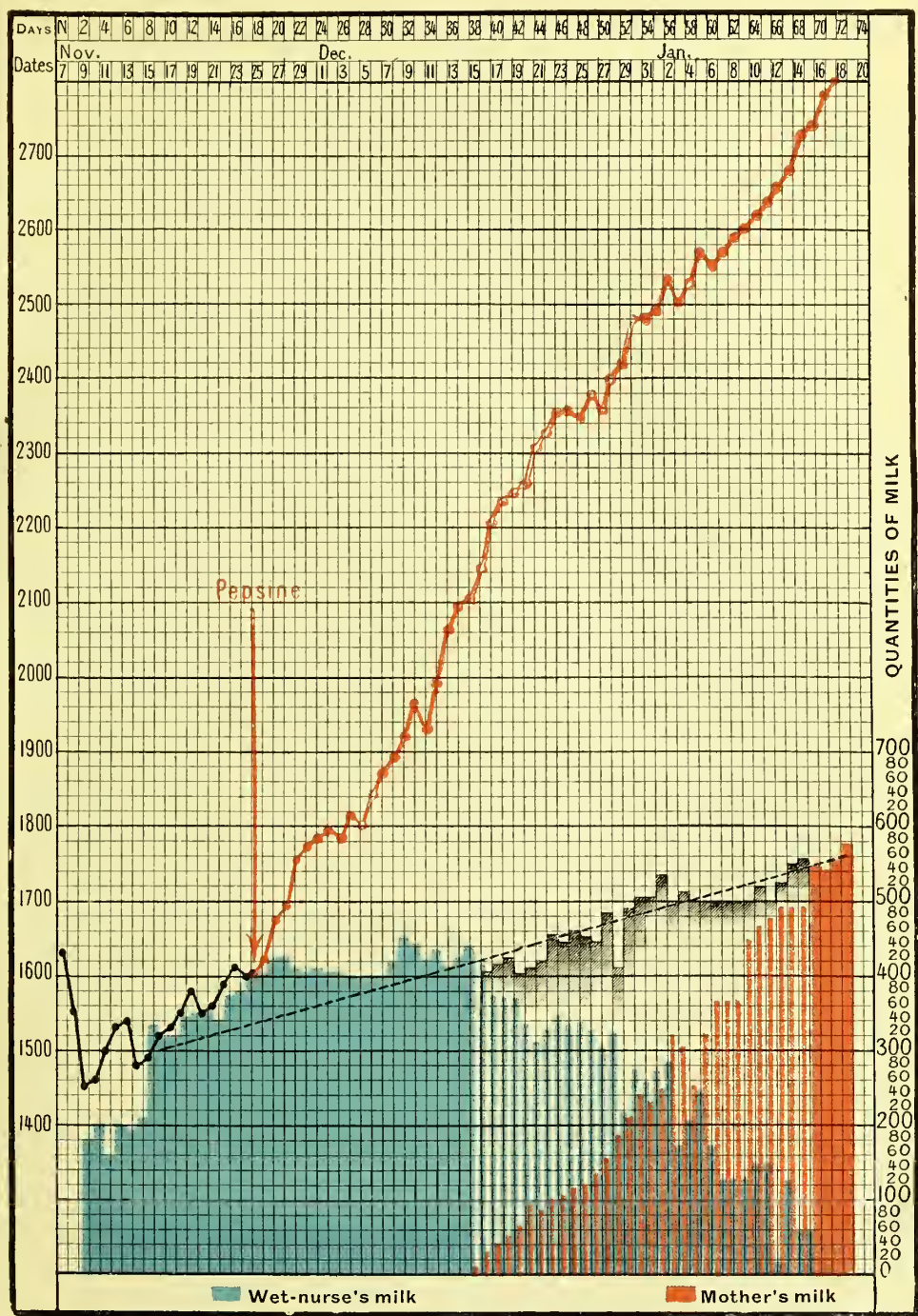


FIG. 34.—Weakling whose weight did not increase satisfactorily till pepsin was given. Suckled first by a wet-nurse (blue columns), then by wet-nurse and mother, and finally by mother alone (red columns).





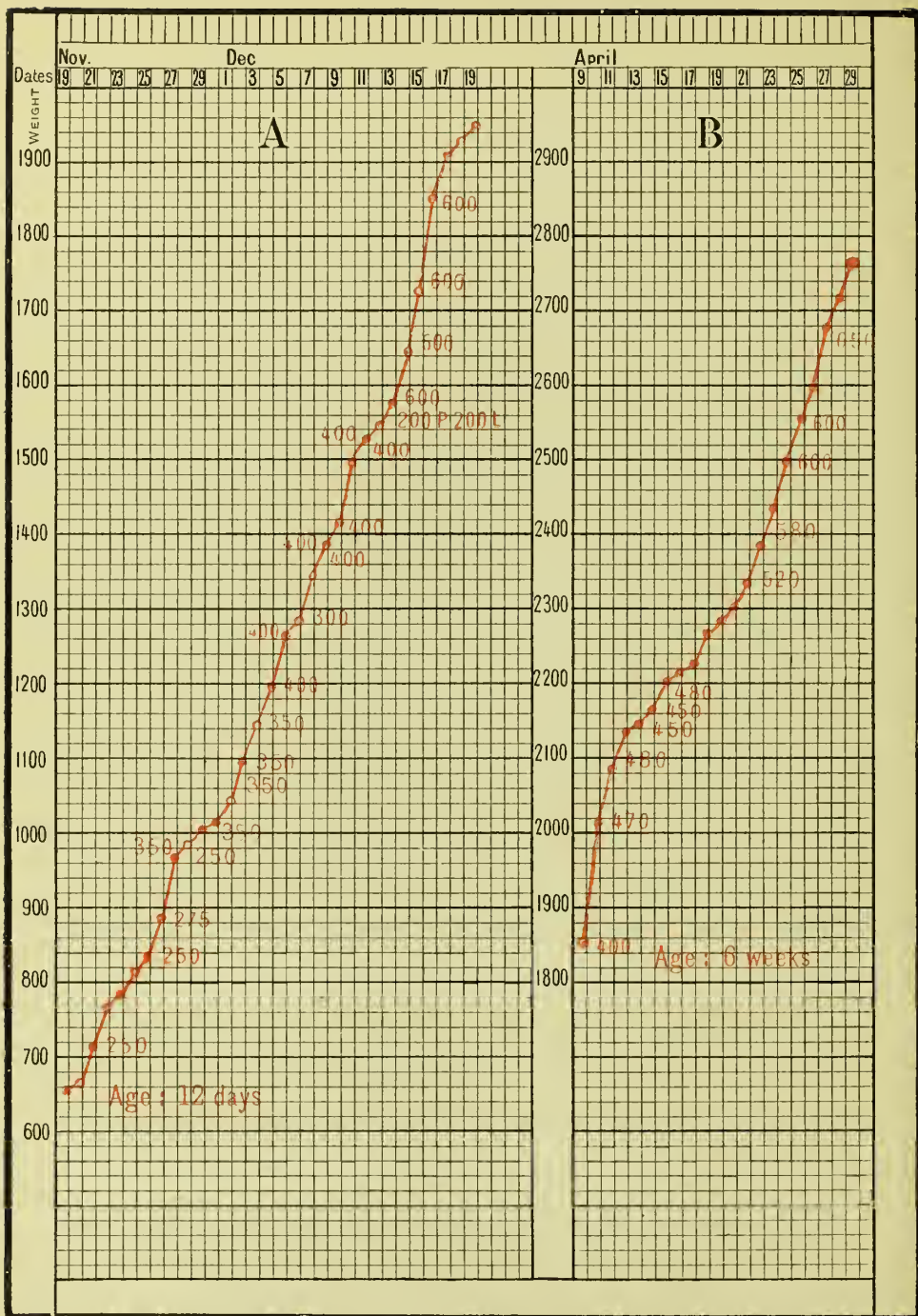


FIG. 35.—A and B, curves of two young dogs reared on artificially digested milk.



weighed 660 grams, and on December 19, 1975 grams, which is an increase of 1315 grams in 30 days, an average of 43.83 grams per day.

Fig. 35B is that of a dog, aged six weeks, which weighed 1850 grams at the beginning of the experiment. During the first ten days it was fed on digested cows' milk uncorrected by the addition of water and sugar; during the next ten days it was given milk digested and also corrected. Taken as a whole this curve is comparable to the preceding.

Convinced by these results, when I encountered weaklings who seemed to assimilate human milk with difficulty I gave this artificially digested milk. Here are several observations:—

The infant G. D. (No. 72) was born at the Maternité on March 11, 1896, weighing 1900 grams. On March 20, when it was admitted to our wards, its weight was only 1780 grams. On March 28 it weighed 1790 grams, an increase of 10 grams, an average gain of 1.9 grams per day (Fig. 36 A and B). As it was remaining practically stationary, it was given digested milk. Immediately it began to increase, and to such purpose that it weighed 2970 grams on May 29. It had added 1180 grams in 61 days, an average of 19.3 grams per day.

Fig. 36A indicates the daily weight of the infant; from March 20 to 28 human milk was given exclusively; from March 28 to April 6 the weakling was also absorbing a certain quantity of digested milk. The daily oscillations in weight, the total quantity of milk consumed, and the character of the stools are here recorded. During the first four days, more or less, of this new régime, the weakling did not take much more than before. Instead of 440, 430, and 420 grams of human milk which he had taken on March 25, 26, and 27 respectively, he drank 440 (350 + 90) grams on March 29, 460 (300 + 160) grams on March 30, 530 (440 + 90) grams on March 31, and 420 (360 + 60) grams on April 1, of human and digested milk combined.

Fig. 36B gives the general tracing, in order better to show the difference in growth between the period in which the infant was fed exclusively at the breast and that in which he was nourished partly on human milk and partly on digested cows' milk.

The infant V——, born on February 5, 1896, weighing 2010 grams, was brought to the department on February 20 and registered as No. 44: he then weighed 1860 grams. On Fig. 37 this diminution in weight is represented by the black line. On

March 2 he weighed 2010 grams. He had increased 140 grams in 11 days, an average of 12.7 grams per day. He was given, from this date, 80 grams, 70 grams, 90 grams, and more, of digested milk per day. On April 16, the day of his departure, he weighed 2940 grams, being an average increase of 20.6 grams per day.

The infant A. M., born at the Maternité on March 3, 1896, weighed 1750 grams: the first two days he lost weight, and fell to 1600 grams. He then slowly increased, and on March 15, the day he was transferred to our wards, he weighed 1660 grams. His number on the yearly register was 67. On March 23 he weighed 1750 grams. He had increased 80 grams in 8 days, an average of 10 grams per day. From March 23, besides the milk of the wet-nurse, he took a certain quantity of digested milk, 30, 60, 100, 140, 160, up to 190 grams per day. On May 14 he weighed 3050 grams. He had, therefore, increased 1300 grams in 50 days, a daily gain of 26.5 grams. On Fig. 38 the dotted line represents the curve from birth to the moment of admission to our wards; the intermediate line following describes the curve when nothing but human milk was being given; and the last line shows the infant's curve when the human milk was being supplemented by digested milk.

For these two infants, and also for the following, I have details showing the quantities of human and digested milk taken each day, the characters of the stools, and the daily oscillations in weight. I have given you only the rough outlines of their histories, so as to throw more prominently into relief the difference in the increase of weight between the periods during which they were given nothing but human milk, and those during which they received digested milk in addition.

The infant N. O. (No. 245), born on July 27 at the Clinique Tarnier, weighing 1700 grams, was brought, a month later, August 27, 1896, to the wards for weaklings; his weight was then 1560 grams. This infant presented multiple syphilitic lesions, coryza, enlarged liver and spleen, &c., so he was given large doses of mercury and potassium iodide. On October 20 he weighed 1850 grams: he had gained only 290 grams in 54 days, which is an average of 5.4 grams per day. From this date he took 70, 130, 160, 190, up to 210 grams of digested milk per day. On December 6 he weighed 2850 grams: he had increased 1000 grams in 47 days, that is 21.27 grams per day (Fig. 39). He was about to leave the hospital, apparently in excellent health, when he died suddenly. At

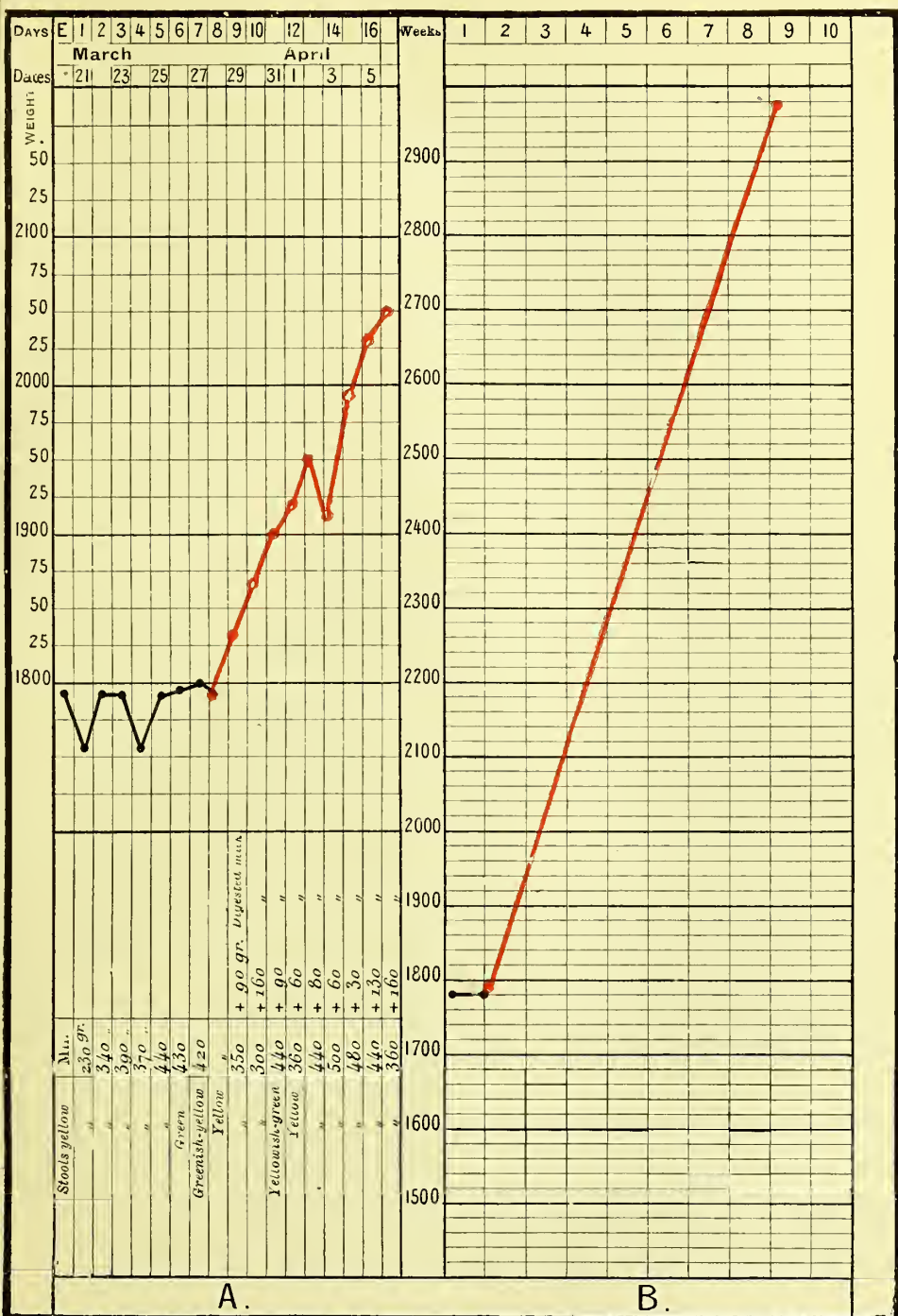


FIG. 36. - Weakling whose weight was stationary. Pre-digested milk was given, and the curve steadily rose. A, curve per day; B, general outline of weekly curve.



the post-mortem examination the spleen was found to be enlarged, and the hepatic tissue to be almost completely replaced by gummata. This infant was tended carefully, and, in spite of being syphilitic, developed in a marvellous fashion. From the point of view of absorption of peptones this is an observation of great value.

Further, you have just seen in the Clinique an infant who, after being fed at the breast or on cows' milk, always vomited and had diarrhœa. In this case we used digested milk (which, for brevity, we shall call "peptones") with entire success.

Born on November 24, 1898, at the Clinique Tarnier, Baby Lendr—— weighed 3800 grams, and when he left hospital on December 5 he weighed 3650 grams. The mother had not enough milk, so five bottles of sterilised milk, each containing 50 grams, were given daily. On December 9 he was still diminishing; his weight was only 3500 grams, so he received seven bottles of 50 grams. On December 16 he was 3700 grams, having increased 22.8 grams per day. In the next 14 days he added 290 grams, or about 21 grams per day; for on December 30 he weighed 3990 grams. On January 9 he reached 4020 grams, and on January 13, when he was brought to me with vomiting and diarrhœa, his weight was only 3800 grams. On January 16 he had lost 290 grams, and the digestive troubles had become worse. Having been admitted with his mother to hospital, he continued to lose weight, and fell to 3610 grams. Dieting and small doses of calomel and naphthol were followed by human milk and peptones, with the result that he very quickly recovered. He left hospital on February 8, weighing 4050 grams, and as the mother had not a drop of milk, the infant was given 350 grams of pure sterilised milk and peptones per day.<sup>1</sup>

Milk artificially digested by the process we have just indicated can, therefore, render very great service. It was invaluable to us in the department for weaklings at the Maternité; with 14 women we were obliged to nourish 54 infants, of whom 14 belonged to the wet-nurses, and 40 were weaklings. If the wet-nurses did not furnish the requisite quantity of milk it was very easy to supplement their supply with "peptones."

Lastly, there is a special contingency which must be provided against in such a department, namely, a strike of the wet-nurses.

<sup>1</sup> This infant continued to do well: on February 17 he weighed 4300 grams; on March 10, 4880 grams; on March 17, peptones were suppressed, and pure milk was given alone; on September 22, 1899, at the age of ten months, he weighed 8140 grams.



If the majority of them suddenly wish to leave they cannot be forced to stay, and it is not an easy matter to replace them immediately. A new wet-nurse requires a certain education before she can make her milk flow into a weakling's mouth, and she needs to learn to draw it off for those who have to be hand fed.

We had to pass through one of those strikes.

When I took charge of the department the wet-nurses were allowed to be present in the wards, when the friends came to see the infants, on Thursdays and Sundays. The consequences of this are not difficult to foretell. Compliments from parent to nurse on the thriving condition of the infant, which were at first verbal, soon assumed a more tangible form. But this was not all. Parents, seeing how their sick and weakly infant was flourishing, did their best to carry off its wet-nurse. I protested vehemently against this iniquitous return for our services. But nothing availed, and lured by golden promises the woman usually departed.

A change had to be made: an order was issued that henceforth no wet-nurse would be allowed to enter the wards during the visit of the parents. Half of their number at once deserted, and we were left with 7 wet-nurses for 47 infants. Thanks to digested milk we were able to feed our weaklings. They did not suffer to any extent, and, little by little, we reorganised the staff.

From what I have said a certain number of practical conclusions may be drawn.

What advice ought to be given in the case of a premature infant? When an infant is born a weakling, either it is—

- A. Entrusted to a wet-nurse, or
- B. Nourished by the mother herself.

A. The infant may be confided to a wet-nurse, or, in Paris, it may be sent to the department for weaklings at the *Maternité*.

a. In private practice, if a weakling be born it is placed in an incubator and provided with a wet-nurse. What generally happens? She leaves her own child at home, and conscientiously gives her breast to the weakling. But the nursing can only suck feebly, and her milk gradually diminishes till it almost totally disappears. The little one makes no progress; he digests imperfectly, and his stools are unhealthy. The wet-nurse is then dismissed, which is a very serious matter for her. Another wet-nurse is engaged, and at the end of some time the result is the same.

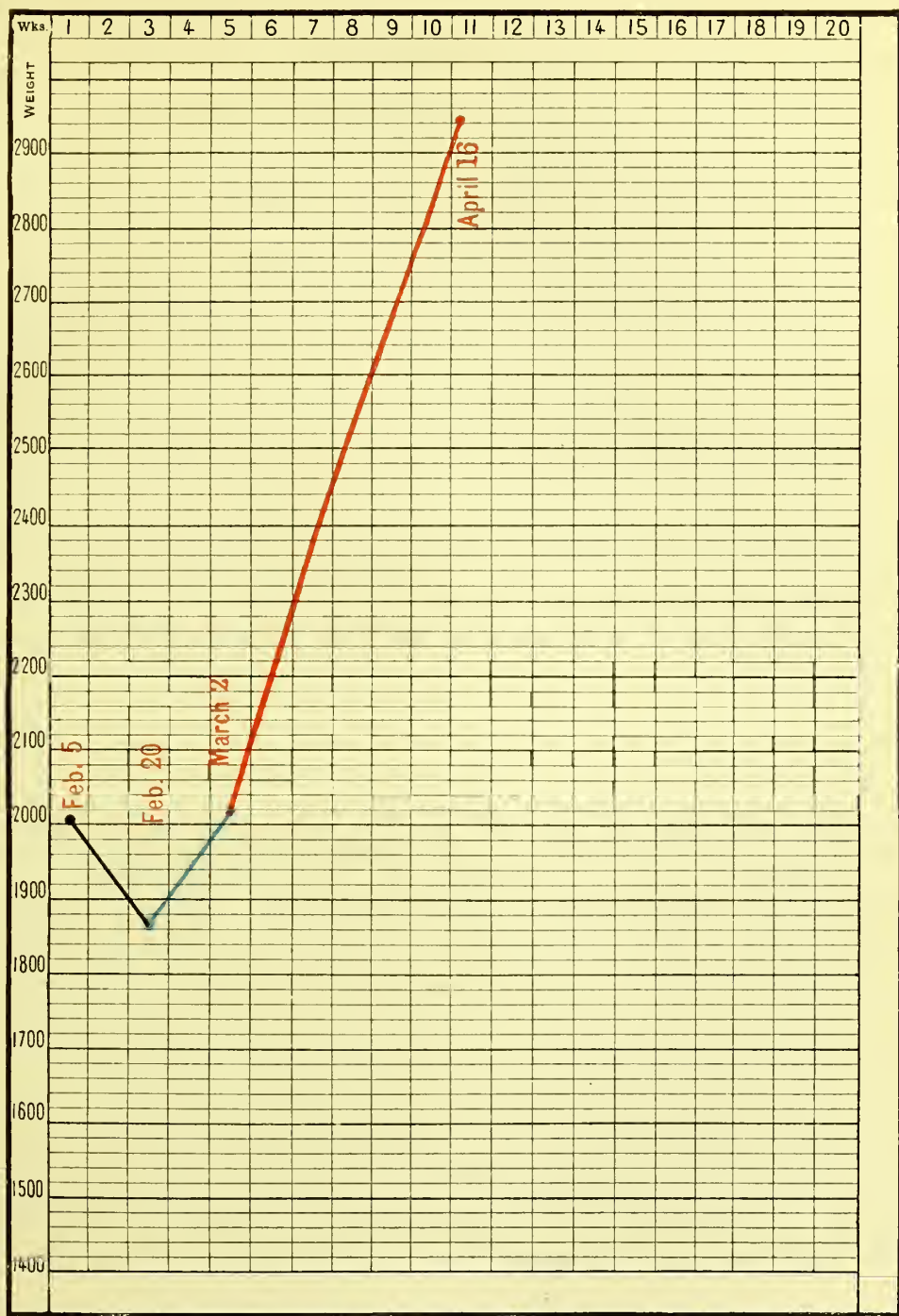


FIG. 37.—Beneficial effect of pepsin in a weakling. Black line, from birth to admittance to the department for weaklings. Blue line, fed by a wet-nurse exclusively. Red line, wet-nurse plus pre-digested milk.





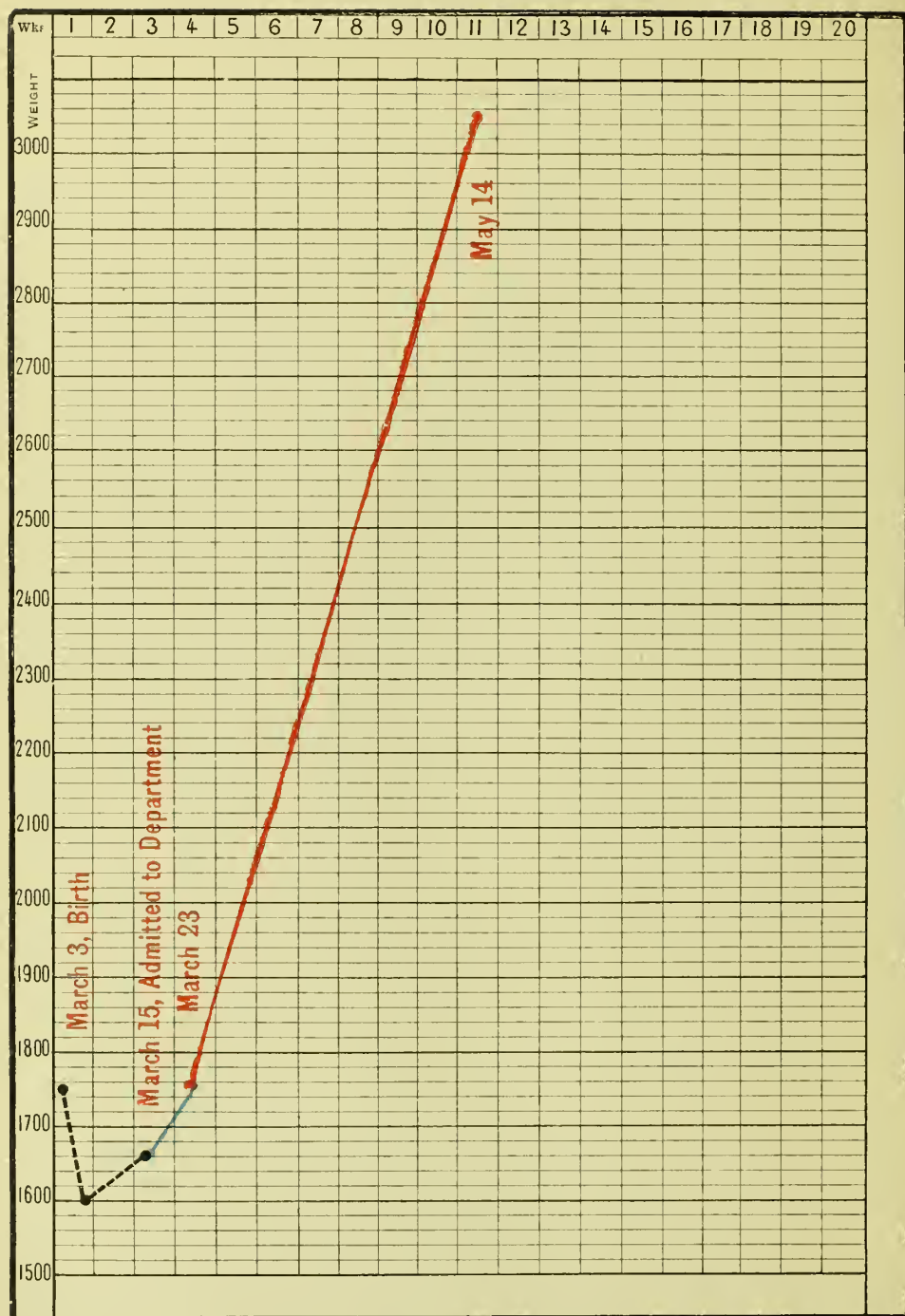


FIG. 38.—General outline of curve, showing beneficial effect of pre-digested milk.



Taught by experience, I proceed differently. When I place a wet-nurse in a family to take charge of a newly-born weakling, I place her there together with her child. I explain to the family that the infant of the wet-nurse is the safeguard of the weakling. Naturally, I first assure myself that the former has no infectious disease. What is the usual course of events? The wet-nurse, sucked by her own healthy infant, retains her supply of milk, and she can give the little weakling all he requires, for she will easily furnish enough for two nurslings. I could cite numbers of successful examples to you. Recall the curve (Figs. 6 and 7) I showed you of an infant who weighed 1270 grams at birth, fell to 1070 grams, and then increased regularly. The wet-nurse in this case was not separated from her own child.

You have seen that it is not difficult to give, according to the nursling's needs, milk which is poor or rich in butter. The former was exemplified by the infant born in Avenue Carnot (Fig. 16, p. 30), which was made to take only the first of the milk flowing from the breast; and the latter by the infant D——, of Rue de Berri (Fig. 17, p. 31), which received the milk richly charged with butter, by being suckled after the infant of the wet-nurse.

When an infant born in a state of congenital feebleness attains a weight of 2900 or 3000 grams and sucks vigorously, he may henceforth be placed under ordinary conditions; the child of the wet-nurse is then not needed.

β. When congenitally feeble infants are brought to the department at the Maternité, every effort is made to rear them, and they do not leave the hospital till they weigh about 3000 grams. But what becomes of them afterwards? The mothers, unfortunately, no longer have milk, and entrust them to strange wet-nurses to be brought up, sometimes on the breast, sometimes, in spite of all our advice, on the bottle.

Unfortunately, also, a certain number of mothers abandon the babies whose needs they have not had to meet, and in whom they have lost all interest. The life of the little one has been saved, it is true, but at the cost of its mother.

Some women of the lower classes, however, do all in their power to maintain their supply of milk, while their little ones are in hospital. The mothers, for example, of the three infants admitted in 1896, and registered under Nos. 49, 84, and 114 respectively, had recourse to repeated milking every day. One woman, whose infant had been brought to us in a state of cyanosis (infant No. 99,

in 1896), suckled a young dog; while another, the mother of infant No. 299, in 1896, paid three francs per day for the privilege of suckling a neighbour's child. A mother, in 1897, who had been delivered of twins, had to place one of them with us (No. 316). She suckled the stronger, and when the weakling left hospital, she was able to provide amply for both. Another woman, delivered prematurely, was forced to place her feeble newly born in the department; but she had another child,  $3\frac{1}{4}$  years old, whom she put to the breast so as to conserve her milk. The little fellow used to stop in the middle of his meal and pretend he wished to leave a share for his baby brother in the hospital. Lastly, I know of two women, one of them the mother of No. 44, in 1897, who made their husbands suck them every day, so that they might retain their milk supply till their infants' return.

These few examples show to what devices a loving mother will resort, in her concern for the welfare of her weakly child.

B. When the mother desires to nurse the weakling, she must be encouraged and aided. How can this best be done?

*a.* If mother and infant are in hospital, it may be found that the weakling is strong enough to take the breast, if the mother be a multipara who has already suckled. In such women milk flows readily and freely, and thus, nursing will be very easy. Unfortunately, however, the infant has rarely sufficient strength to suck. In that event the milk of a good wet-nurse should be given to it from a spoon or glass, or even by gavage, till it becomes stronger. In the meantime a larger, full-term infant is put to the mother's breast, so that lactation may become fully established, and the milk flow plentifully. After the infant is able to suck, the mother can nurse it, and she leaves hospital with her baby weighing 2800 to 3000 grams. A weakling no longer, it is also endowed with a mother personally capable of nourishing it. The mother, too, is more devoted to her child, from the very fact that it has been so difficult to rear. Many infants born in a state of congenital feebleness have thus happily left our wards robust and thriving, and continued then to follow our Consultation as breast-fed babies.

Let me give you two examples.

The infant Mong——, at his birth on November 7, 1898, weighed 1625 grams; his weight fell to 1450 grams. He was first fed by a wet-nurse, and the mother, who had suckled in the meantime a stronger infant, began to nurse him herself on December 14.

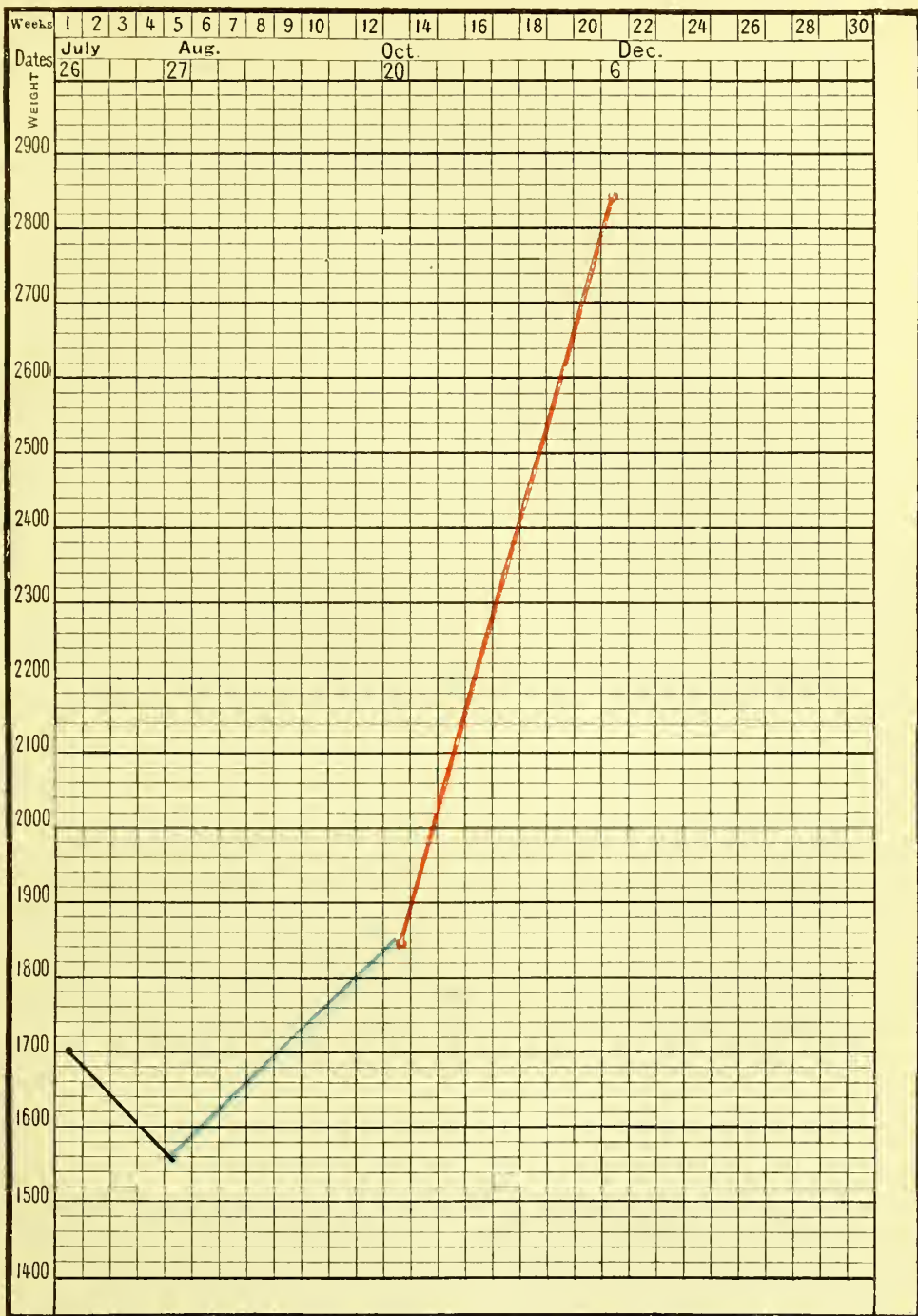


FIG. 39.—Outline of curve to show effect of pre-digested milk.







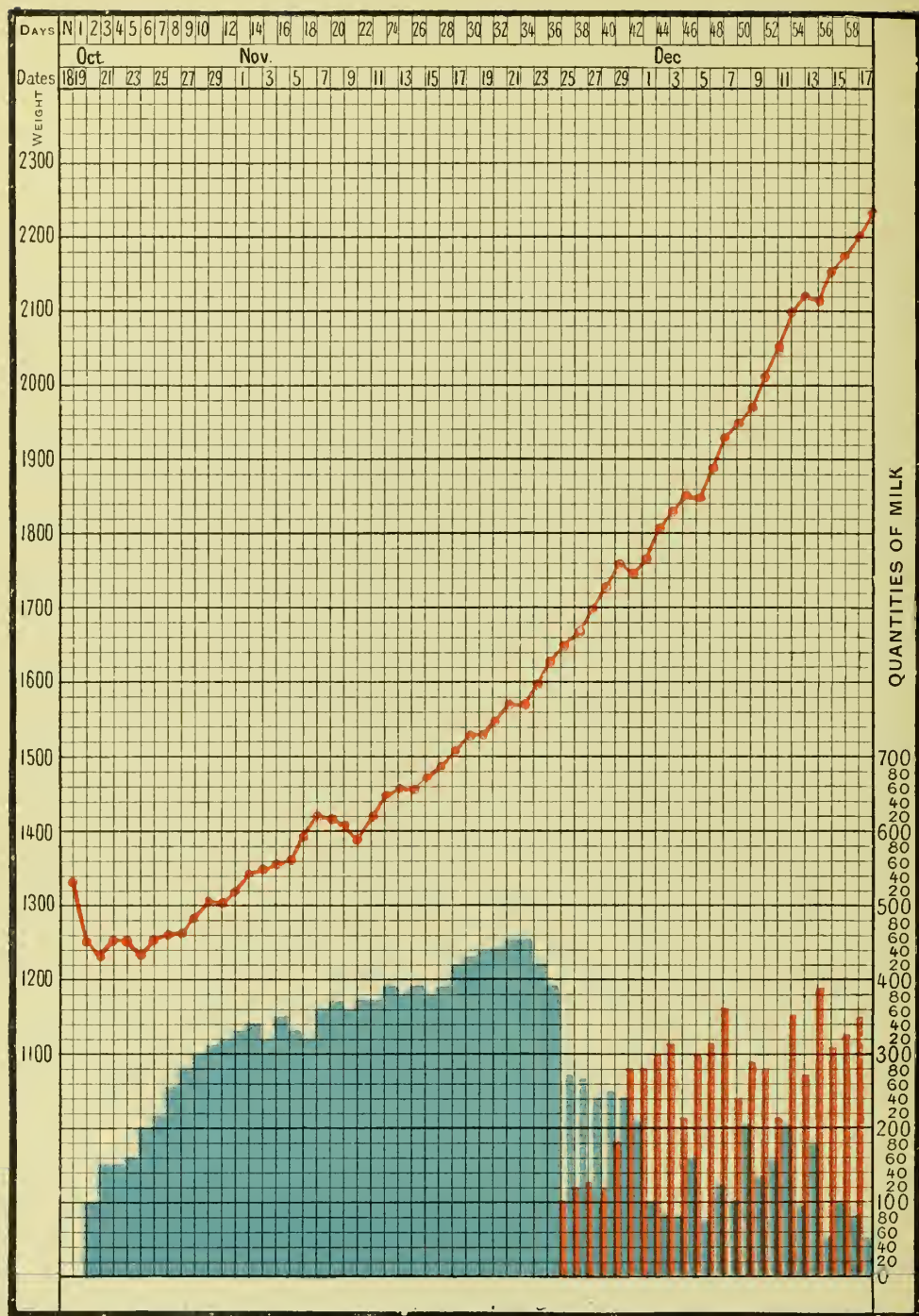


FIG. 49.—Puny weakling first fed with the milk of a wet-nurse (blue columns), the mother in the meantime suckling a stronger infant in order to bring about the establishment of her mammary secretion (red column). The mother became capable of nursing her child unaided.

The quantity of milk she furnished to him went on increasing, whilst that which the wet-nurse provided was diminished proportionally. On January 15 the wet-nurse was dispensed with altogether, and on January 16, the day of their discharge from hospital, the baby weighed 2800 grams, and the mother continued to suckle it.

An infant born prematurely on October 18, 1898, weighed 1330 grams (Fig. 40). The mother had had much bleeding from an abnormally situated placenta, and the child was first entrusted to a wet-nurse. On November 24 the mother, who till then had been nursing a stronger infant, began to suckle her own little one. She carried it from hospital on December 16, weighing 2230 grams. Since then she has fed it unaided, and, as you can see any Friday at our Consultation, it is doing splendidly.

β. What must you do in similar cases in private practice? There is little or no milk in the breasts of the newly-delivered mother, and the infant cannot suck. It is best then to bring in, temporarily, a wet-nurse with her child, defining precisely the terms of her engagement. She will supply the weakling with milk; it will be fed by gavage, if necessary, or by a spoon until it is strong enough to suck. By nourishing her own baby at the same time, she will maintain and stimulate her lacteal secretion. On the other hand, the mother of the weakling will nurse the infant of the wet-nurse, until her mammary secretion is fully established; on the day when her little one is able to suck vigorously, and she can minister to its wants, the wet-nurse will be discharged.

The mother is satisfied because she can now fulfil her function. The wet-nurse is satisfied, for not only has she been well paid for her services to the weakling, but she has also been allowed to keep and tend her own child; further, she has proved her worth and will easily find another client. Let me add that the medical attendant finds every reason to feel gratified with such a happy termination to his efforts.

You see, gentlemen, these studies have very important practical bearings.

In our next lecture I shall point out how easily these little beings become infected. We shall seek to ascertain what becomes of them in after-life; and I hope to draw some conclusions, first from an obstetrical, and secondly from a social point of view.

## LECTURE IV

SUMMARY:—Facility of infection of the newly born in hospitals—Liability of congenitally feeble infants to contagious diseases—Epidemics of influenzal bronchitis in 1895, 1896, and 1897—High mortality among weaklings.

Epidemic of chicken-pox—"Bronze" disease—Ophthalmia—Precautions to be taken in hospital and in private practice.

Description of the wards for weaklings at the Maternité—Modifications proposed to obviate infection—Their adoption.

Results obtained at the Maternité in 1895, 1896, and 1897—Number of infants who died—Number of infants who survived.

Results obtained at the Clinique Tarnier in 1898—Comparison—Causes of the difference.

Fate of premature infants after their discharge from the department for weaklings at the Maternité, when breast-fed and when bottle-fed.

Statistics relating to full-term infants.

Results obtained at the "Pouponnière"—Numerous desertions—Right of weaklings to their mother—Intellectual and physical development of infants born congenitally feeble.

Induction of premature labour in cases of contracted pelvis—Results.

GENTLEMEN,

To-day I should like to finish what I have to say with regard to weaklings.

You recollect we studied the disastrous effects of the lowering of their temperature. I showed you that their feeding must be directed with the greatest care, for, underfed, they are liable to attacks of cyanosis; and, overfed, to digestive troubles and diarrhœa. We have yet to consider, however, the important question of the contagious diseases which attack weaklings placed together in a common ward.

A short time ago you had a demonstration of the facility with which infants can become infected in a hospital. Here, in the Clinique Tarnier, where we are without distinct isolation wards, two women suffering from sore throats were admitted and placed in the same general ward. The trouble spread among the other patients. We at once took all the precautions possible with our defective organisation. There were no fatalities among the mothers; all rapidly recovered.

It was otherwise, however, with the infants. They offered much

less resistance, and the contagion, spreading to them, gave rise, in some cases with fatal results, to erysipelas and broncho-pneumonia. Here it was a question of healthy, full-term infants ; but weaklings, puny little beings, who often are ill before they are brought to us, can still more easily be infected.

I have already alluded to what took place at the pavilion for weaklings at the Maternité. In 1895 all was going smoothly when, on a cold and damp winter afternoon, November 26, the wet-nurses, in spite of all remonstrance, went out with their infants. Next morning three were coughing and nine of the infants were ill. The following day the six remaining infants were also attacked.

Our great dread was lest this affection, which had broken out so suddenly, should spread to the weaklings. Apart from coryza, respiratory troubles had been relatively rare in the wards ; we had had only one case of bronchitis from July 1 to November 27, for an infant that began to cough was always immediately isolated.

But how was the spread of the disease to be prevented ? The wet-nurses, not having a special room in which to tend their infants, constantly brought them into that used for the weaklings. This practice was prohibited, and orders were given to the nurses to leave their infants in their own dormitory. Other precautions were taken, but notwithstanding, six days later, December 3, the epidemic broke out among the weaklings. At first 17 were attacked, but it gradually spread till nearly all were involved. On December 5 the wards were closed.

This epidemic was exceedingly fatal to these frail little creatures, scarcely able to exist outside an incubator : 34 were affected and 23 died. Congenital feebleness, as is shown by experience, greatly diminishes an infant's power of resistance. Among the weaklings 23 out of 34 died, a mortality of 67.6 per cent., whilst amongst the infants of the wet-nurses only 1 died out of 15, a mortality of 6.6 per cent. (Fig. 41).

After the epidemic was over the wards were reopened, and everything proceeded regularly once more. Towards the end of 1896 another epidemic broke out. On November 26 three infants of wet-nurses were taken ill. The affection spread to the others, and soon all fifteen were implicated, without, happily, any fatal results.

In spite of all our precautions the weaklings were attacked. We prohibited the infants of the wet-nurses from being taken into



the dressing-room for the weaklings. We obliged every wet-nurse to wash her face and hands, and change her uniform each time she went to feed the weaklings, but nothing availed, and eighteen days after the first appearance of the epidemic two weaklings were affected. The disease gradually spread among the greater number of them, and on December 26 the wards had to be closed. Out of 25 seized with this influenzal bronchitis, 4 died, a mortality of 16 per cent. (Fig. 41).

In 1897 we had not one but two epidemics of bronchitis, the first in March, the second in November.

In March, 13 infants of wet-nurses were attacked, but all recovered; 28 weaklings were affected and 16 died, a mortality of 57.4 per cent.

In November a sick weakling seemed to be the starting-point of the epidemic; 9 infants of the wet-nurses suffered without any fatalities, but out of 34 weaklings attacked only 16 survived; 18 died, which was a mortality of 52.94 per cent.

You see, gentlemen, how easily these affections can be contracted, not only by weaklings, but also by full-term infants. The latter, however, being stronger, resist better, and in the three epidemics to which I have referred, there was only one death among the children of the wet-nurses. What a contrast with the weaklings! Look at the mortalities among them: 16 per cent., 52.94 per cent., 57 per cent., and even 67.6 per cent.

Besides influenzal bronchitis there has also been chicken-pox. At the time of my entry into the Maternité in 1895, it was the custom, when a woman about to be confined arrived with her children during the night, to leave the latter in the wet-nurses' dormitory till next day. I ordered them to be immediately taken to "Les Enfants Assistés" without being allowed to enter our wards. But this precaution was too late: an infant of a wet-nurse had already contracted chicken-pox. Without delay it was sent with its mother to a hospital for contagious diseases. In order that the weaklings might by their night feeding inconvenience the wet-nurses as little as possible, it was then customary to carry them in their incubators from their mother's bedside to the dormitory of the wet-nurses. One of these little beings contracted chicken-pox among the wet-nurses, and a small epidemic ensued. The incubation period was thirteen days.

I have also observed a strange affection, characterised by bronzing of the skin, the precise nature of which is not yet known.



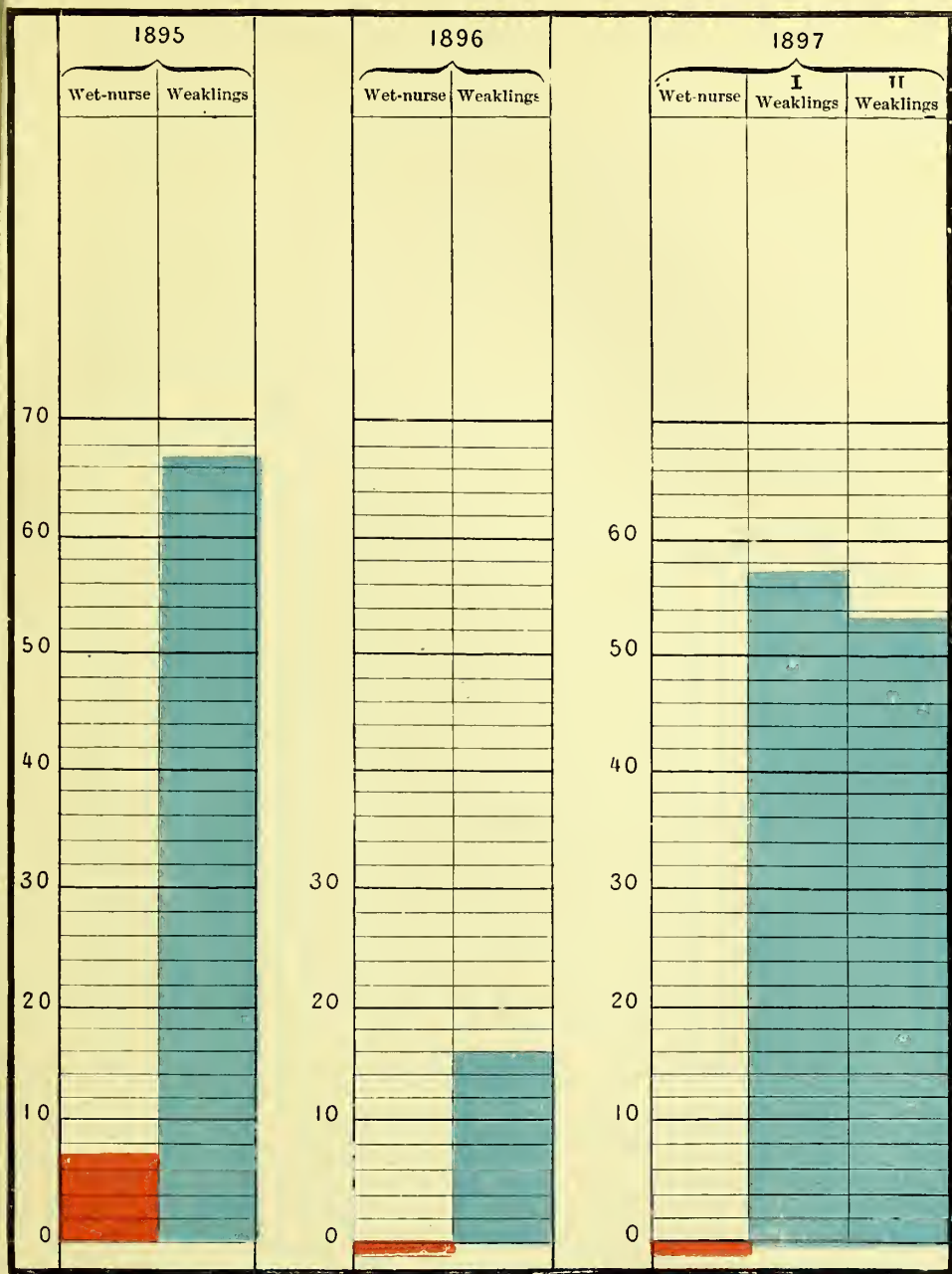


FIG. 41.—Epidemics of bronchitis at the department for weaklings in 1895, 1896 and 1897. Red columns, percentage of deaths among the wet-nurses' children. Blue columns, percentage of deaths among the weaklings.



In 1896 we had thirteen cases ; all ended fatally. It is essentially a contagious disease, and any infant attacked by it ought to be at once isolated.

Among infants brought from outside we have had many cases of ophthalmia. At the Maternité we hardly ever saw it, for we treated the eyes with a few drops of a solution of silver nitrate, 1 in 150, immediately after birth. But infants born outside the hospital, in whom no preventive measures had been employed, very readily took conjunctivitis. It even seemed as if the temperature of the incubator favoured the development of this affection, so we made it a rule to put a few drops of a weak solution of silver nitrate in the eyes of every infant we admitted.

Ophthalmia is an annoying affection ; it requires frequently repeated attention ; it is dangerous and contagious, and moreover, it often gives rise to coryza, which may prevent the infant sucking, and necessitate feeding by spoon or gavage.

These facts demonstrate the numerous dangers of infection to which the newly born are exposed. The weaklings, especially, run great risks ; in these epidemics the mortality among them from influenzal bronchitis was considerable and even appalling, whilst among the infants of the wet-nurses it was practically nil.

In your practice, therefore, you must immediately isolate any infant suffering from influenza, or all the other children in the house will also take it. And, further, if you have to choose for a weakling a wet-nurse and her child, you must carefully examine the latter to ascertain if it has any contagious disease.

I told you that the department for weaklings at the Maternité was defective in its organisation ; no provision had been made for the possibility of contagion.

The following is a description of it which I gave in 1896, together with the modifications which I then proposed :—

“The department for weaklings is, at present, constructed thus :—

“A. On one side there is a large ward containing the weaklings in their incubators and cradles ; at one end of this ward there are four small rooms for isolation.

“B. On the other side there is the wet-nurses' dormitory, at one extremity of which are the dining-room, dressing-room, pantry, lavatory, &c.

“Between these two divisions is a ward, generally kept at a

temperature of  $24^{\circ}$ – $25^{\circ}$  C., where the weaklings are undressed, washed and fed. This ward, being unique, serves for all, so the infants of the wet-nurses are there constantly. If one of them has any contagious malady the weaklings can easily become infected. How can this be avoided?

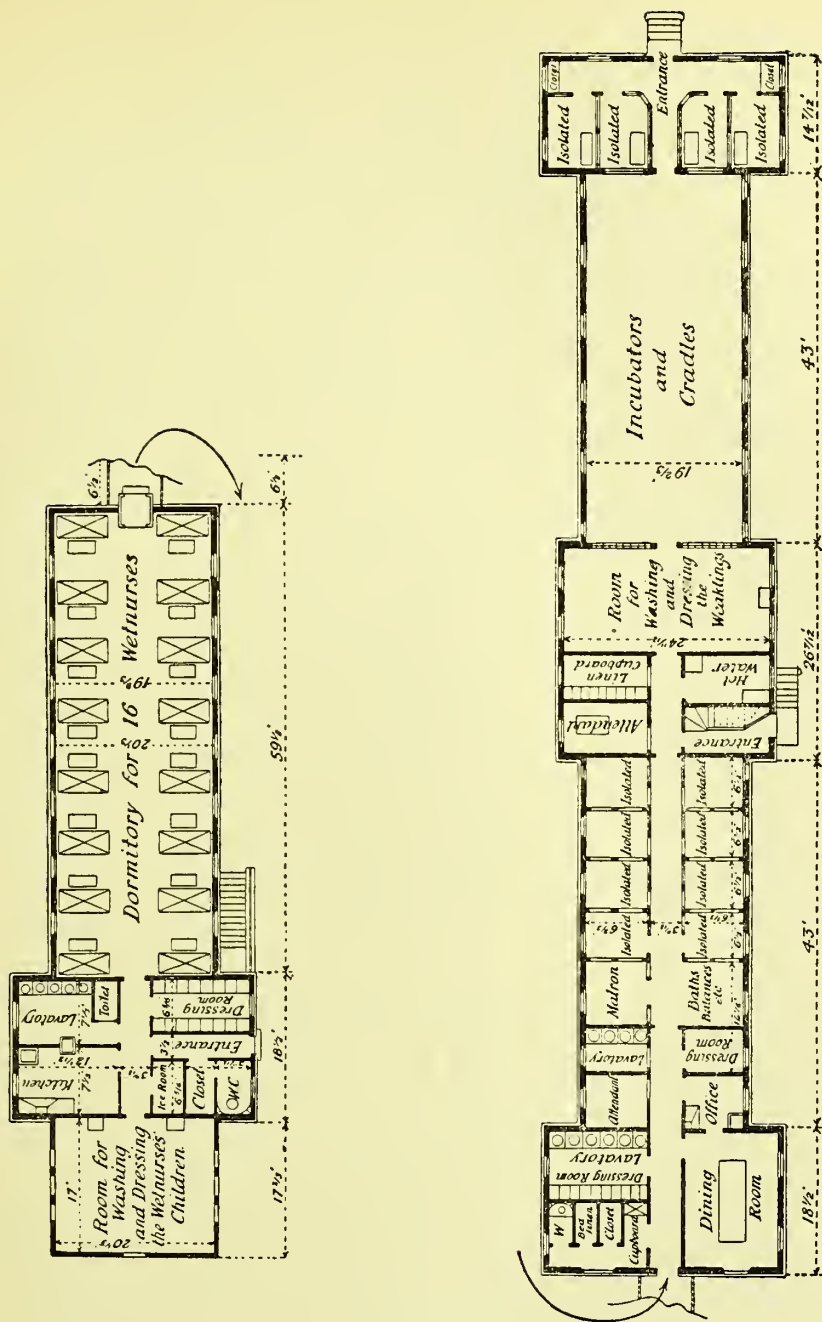
“1. Wet-nurses could be taken without their infants, as is done at ‘*Les Enfants Assistés*.’ This would be a great advantage, inasmuch as it would get rid of the principal cause of infection. But it must not be forgotten that we have to deal with weaklings. If some, grown strong, can suck vigorously, others, still feeble, can scarcely suck at all, whilst others again have to be hand-fed, and the wet-nurse has to draw off her milk either by means of a ‘breast evacuator’ or by pressure of the fingers. Suckling maintains in a mother her milk production. What would happen if the wet-nurse was deprived of her own infant—the physiological stimulus of her mammary secretion?

“And if, in spite of all precautions, an epidemic were to take place, so that during a certain time no weaklings could be admitted, the wet-nurses would be in danger of losing their supply of milk, and with it their chief means of living.

“2. If, then, the infants of the wet-nurses have to be allowed to stay with their mothers, they must be completely isolated. There ought to be, therefore, a pavilion specially reserved for the wet-nurses, so that under no pretext whatsoever shall their infants cross the threshold of the wards for the weaklings.

“But this is not all; there is a further possible source of infection in sick infants brought from outside. No matter what we did we could never restrict the wards for weaklings absolutely to infants suffering solely from congenital feebleness. Certainly, the majority admitted are infants born before term, premature but healthy; yet, many are brought, several days and even weeks old, suffering from gastro-enteritis, suppuration of the cord, conjunctivitis, erysipelas, &c. In 1895, 395 infants were received, of whom 117 had some pathological condition. They were feeble, puny, and weakly, but they were also ill. To receive only congenital weaklings, and to refuse those whose debility is acquired, are practically impossible. We tried it, but without success, and, meanwhile, those weaklings who are ill are a source of danger to the others.

“Hence, I believe it would be necessary to establish three divisions in the department.



PLAN OF THE DEPARTMENT FOR WEAKLINGS  
AT THE MATERNITÉ





"In the first would be placed the congenital weaklings, transferred from the wards of the Maternité or admitted immediately after birth, who did not present any symptoms of infection.

"The second would be reserved for weaklings who were either ill, or not free from suspicion of infection, such as those coming from the wards of other hospitals, or from midwives.

"The third, totally distinct from the other two, would constitute the pavilion for the wet-nurses.

"It remains for me briefly to indicate how I would proceed to organise each of these separate divisions.

"First Division—Healthy weaklings.

"This would comprise the department as it at present exists—a large ward for the cradles and incubators, four small isolation rooms, a room in which to dress and undress the infants, provided with balances, baths, hot and cold water, &c., and a small room for putting the linen of any infant whose dejections have to be kept for the doctor's inspection.

"Second Division—Weaklings ill or suspected.

"This would comprise a certain number of rooms destined to receive either only one or two infants.

"At one extremity of this division there would be a room in which all that is necessary for tending and feeding infants, such as baths, balances, breast evacuators, &c., would be kept, but each infant would be cared for in its own separate room. At the same end there would also be an apartment to serve as a dressing-room and lavatory for the wet-nurses, where, before ministering to any of the weaklings thus isolated, they could wash their hands and face and don an overall.

"Third Division—Pavilion for wet-nurses.

"This would be quite distinct from the other divisions, separated by an interval of  $2\frac{1}{2}$  metres, covered in so as to protect the wet-nurses from rain. It would comprise one large common ward, containing sixteen beds for the wet-nurses and sixteen cradles for their children. A small passage at one end would lead to a large, airy apartment with cribs, balances, hot and cold water, &c., where the infants would be bathed and dressed. In a small room apart, sterilised milk would be heated for the infants, and food prepared for the older children. The bottles of sterilised milk would be kept in a cool place, and during summer a small ice chamber might be provided for them. There would also be a water-closet and other conveniences, with a small passage opening out into the

yard, so that these rooms might be cleaned without refuse having to pass through the wet-nurses' dormitory. Lastly, there would be a dressing-room for the wet-nurses, and an apartment in which each of them would have a cupboard for keeping her clothes.

"Thus would be brought about—

"1. The grouping together of the healthy weaklings.

"2. The isolation of the sick and suspects.

"3. The absolute separation of the wet-nurses' infants from contact with the weaklings."

The public authorities were quite willing to permit the realisation of this programme. My successors, I hope, will now be freed from the difficulties I had to contend against, and able successfully to avoid the spread of any contagious affection in the department at the Maternité. This new organisation has been in existence one year so far without a single epidemic. Here, at the Clinique Tarnier, in spite of the defective system, there have been no epidemics among our weaklings, for no precaution is neglected.

What were my results at the Maternité? I do not wish to enter into a fastidiously detailed study of the figures, year by year, as I have already published the statistics for 1895, 1896, and 1897. I shall simplify the matter by grouping these three years together, and then I shall show you, for the sake of comparison, my results here, at the Clinique Tarnier, in 1898.

Let us first take the department for weaklings at the Maternité. By dividing the infants according to their weight on admission we get four categories—

- I. The first category comprises infants who weighed less than 1200 grams.
- II. The second category comprises infants who weighed from 1200 to 1499 grams.
- III. The third category comprises infants who weighed from 1500 to 1999 grams.
- IV. The fourth category comprises infants who weighed 2000 grams and more.

Here are the results in tabular form :—

Categories.	Weight in Grams.	Number of Infants.	Dead.		Living.	
			Total.	Proportion per Cent.	Total.	Proportion per Cent.
I. . .	Less than 1200. .	40	38	95	2	5
II. . .	From 1200 to 1499	146	124	85	22	15
III. . .	From 1500 to 1999	432	265	61.34	167	38.6
IV. . .	2000 and over . .	212	69	32.55	143	67.45

Thus for 40 infants weighing less than 1200 grams the mortality was 95 per cent. ; 5 per cent. were saved.

For 146 infants weighing from 1200 to 1499 grams, the mortality was 85 per cent. ; 15 per cent. were saved.

For 432 infants weighing from 1500 to 1999 grams, the mortality was 61.34 per cent. ; 38.6 per cent. were saved.

For 212 infants weighing more than 2000 grams, the mortality was 32.55 per cent. ; 67.45 per cent. were saved.

Considering all these infants together, 40 per cent. left the wards in good health.

Evidently we cannot say that these figures are extremely favourable ; however, we succeeded in saving 38.6 per cent. of the infants who weighed between 1500 and 2000 grams, and 67.45 per cent. of those who weighed more than 2000 grams, usually between 2000 and 2500 grams. But the state in which these weaklings were so often brought to the Maternité must not be forgotten. A large number of them, 27 per cent., or almost a third, arrived with a rectal temperature of less than  $33.5^{\circ}\text{C}$ . ; in addition, the majority of them were already suffering from digestive troubles, diarrhœa, sclerema, ophthalmia, &c. ; and lastly, they were scourged by contagious diseases, for 61 died from influenzal bronchitis alone, in the three years.

I think I can safely assert that the results would have been vastly superior if we could have shielded the infants from their three chief enemies, cold, digestive troubles and contagious maladies. Here is a proof of this.

I have made an abstract of the infants who were born at the Clinique Tarnier, with a weight of 2500 grams or less, between March 1898, when I took charge of the hospital, and December 31 of the same year. In order to render the figures comparable to those derived from the department for weaklings, I have omitted all infants who died within forty-eight hours, for I did not count those

brought to the Maternité who did not survive more than two days. Neither have I included those who at birth weighed more than 2500 grams and subsequently fell below that figure.

There were 144 infants, and I shall, as before, separate them into four categories :—

Categories.	Weight in Grams.	Number of Infants.	Dead.		Living.	
			Total.	Proportion per Cent.	Total.	Proportion per Cent.
I. . .	Less than 1200. .	1	1	100	0	0
II. . .	From 1200 to 1499	5	3	60	2	40
III. . .	From 1500 to 1999	30	4	13.3	26	86.7
IV. . .	From 2000 to 2500	108	7	6.4	101	93.6

For infants weighing less than 1200 grams, our mortality was 100 per cent., but as we had only one infant in this category the figure is without significance.

We had 5 infants weighing from 1200 to 1499 grams ; the mortality was 60 per cent. ; 40 per cent. were saved.

For 30 infants weighing from 1500 to 1999 grams, the mortality was 13.3 per cent. ; 86.7 per cent. were saved.

For 108 infants weighing from 2000 to 2500 grams the mortality was 6.4 per cent. ; 93.6 per cent. were saved. Among the 7 who died, 5 were syphilitic. Eliminating these, we lost 2 infants out of 103, a mortality of 1.84 per cent.

If we group together all these infants who weighed less than 2500 grams, we find that 129 out of 144, that is 89.5 per cent., left the Clinique Tarnier in good health.

On Fig. 43 the results obtained at the two hospitals are compared ; the red columns represent the mortality among the weaklings at the Maternité ; the yellow, at the Clinique Tarnier.

A considerable difference is seen to the credit of the Clinique Tarnier. Why ?

It is not a question of the relative amount of care bestowed on the weaklings. I had charge of both institutions. A little hesitant at first, gradually experience gave me the confidence which I now possess. As for my staff, they were as intelligent, faithful and perfect at the Maternité as they are at the Clinique Tarnier. So we must look elsewhere for the cause.

At the Maternité, infants were often brought with a considerable lowering of temperature ; at the Clinique, we took every precaution to avoid the exposure of our infants to cold.



# TOTAL MORTALITY

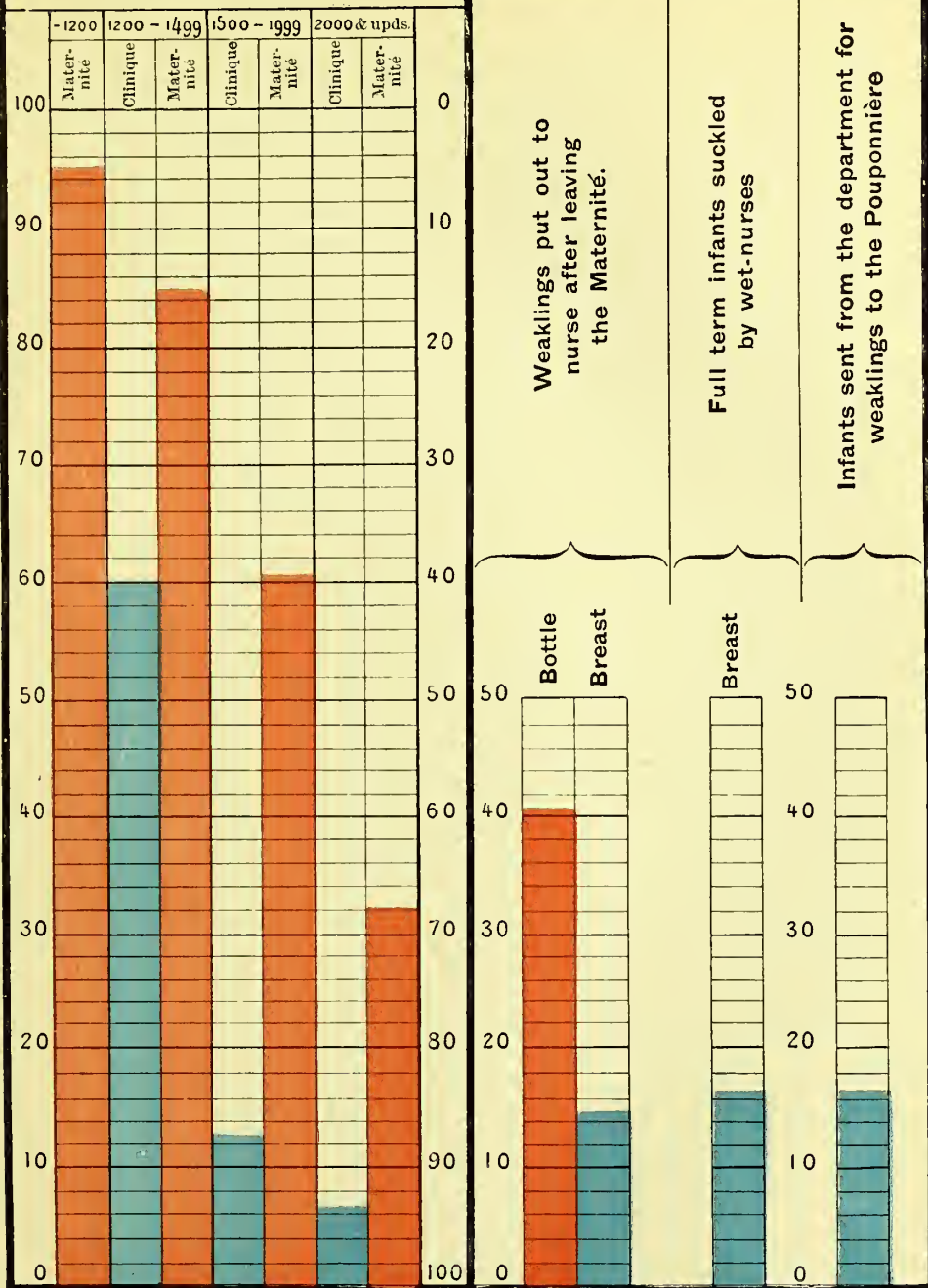


FIG. 43.—On the left: Comparison of the death-rate among weaklings at the Maternité (red columns) and at the Clinique Tarnier (blue columns). On the right: The description is placed above each figure.



At the Maternité many infants, on admission, were already suffering from digestive troubles ; here by attentively supervising the feeding, all digestive troubles were avoided.

Lastly, at the Maternité there were several deadly epidemics of influenzal bronchitis, while at the Clinique we succeeded in protecting the weaklings against such calamities.

These are the reasons of the high mortality among the weaklings at the Maternité. The low death-rate among them at the Clinique Tarnier is the product of a wider experience.

I think I am justified in concluding that if every precaution was taken to avoid depression of temperature, digestive troubles, and contagious diseases, the great majority of weaklings would be saved.

What becomes of these infants when they leave hospital and return to their homes? What is their mortality then? How do they develop physically and intellectually? I have made a certain number of observations, of which I shall now give you the results.

I sought to ascertain what became of the infants who were cared for in the department for weaklings from January 1 to October 1, 1896. I commenced my inquiry on December 1 ; the infants had then left us at least two months, and at most ten. Many letters were undelivered, as the mothers had left their former addresses and could not be traced. For 73 infants we had 54 answers ; we were therefore without information regarding 19.

Out of these 54 infants who, at the moment of their departure, weighed between 2800 and 3000 grams, 37 were living and 17 were dead ; the total mortality was thus 31.5 per cent. These were infants for whom we had zealously cared ; we had given them to their families in good health, and they had been allowed to die in a proportion of 31.5 per cent. Only 68.5 per cent. had survived, which was not a very encouraging result.

But let us go further, and see how these infants were fed. We had strongly recommended that they should be breast-fed, but unfortunately our advice was not followed.

Among these 54 infants—

20 were exclusively breast-fed.

24 were exclusively bottle-fed.

3 were partly fed on the breast, partly on the bottle.

1 was breast-fed at first, and then bottle-fed.

6 were on a régime, concerning which no particulars were returned.

Out of the 24 bottle-fed, 10 died, which makes a mortality of 41 per cent.

Out of the 20 breast-fed, 3 died, so their mortality was 15 per cent.

The mortality among bottle-fed infants is therefore very much higher than that among those who are breast-fed. We have saved only 59 per cent. of infants reared on the bottle, but 85 per cent. of those reared on the breast.

But, in order to form a correct estimate of these results, I required to know in what proportion full-term infants die, so I proceeded as follows :—

Infants born at the Maternité are fed by their mothers, and do not leave the hospital till she does ; if they had to be put out to nurse, I authorised their departure before the mother's only if they were confided to a wet-nurse to be reared at the breast. During that same year, 1896, I noted the names of all such infants, together with the names and addresses of their wet-nurses. The following year, 1897, I asked the authorities to make an inquiry as to the fate of each of these infants. This was done with great thoroughness, and the following results were obtained : 91 women received infants to be breast-fed ; two of them could not be traced ; of the other 89, one had twins, and thus there was a total of 90 infants.

Four of these 90 had been taken home by their parents before the end of the second month. Of the remaining 86, 15 had died, which is a mortality of 17.4 per cent.

Hence, among well-developed full-term infants, in whom no congenital defect was found, and who were reared at the breast, there was a mortality of 17.4 per cent.

Our weaklings under similar conditions, confided to wet-nurses to be breast-fed, died in the proportion of 15 per cent. Therefore these infants leaving the department for weaklings are quite viable ; indeed, they are as much so as infants born at full term, for their death-rate is less.

These infants were confided to breast wet-nurses, or rather to so-called breast wet-nurses. As one is very easily deceived, I took the trouble to ascertain from the State register of births, the age of the last child of each wet-nurse, and found a record of infants of one, seven, eight, nine, fourteen, nineteen, and even twenty years. But this fraud was short-lived, and only true breast wet-nurses, *i.e.* women several months delivered, were employed. This source of fallacy, therefore, does not materially affect the results ;

and besides, it applies equally to both weaklings and full-term infants.

We are thus justified in concluding that a weakling, when it is discharged from our wards, is as capable of existing as a full-term child.

I have been enabled still further to verify this conclusion. The philanthropy of M. Henri Bamberger has created at Versailles a very interesting organisation, called the Pouponnière, where infants are raised, at first exclusively on the breast, later on a diet of human and cows' milk combined. It is directed by ladies with the scientific aid of a medical committee. A certain number of infants are admitted, some of whom are received gratuitously; and there are, in addition, the children of the wet-nurses, for these are not alienated from their mothers. This institution consists of three pavilions, of which two are reserved for full-term infants, and one for those who, in due course, have been discharged from the department for weaklings at the Maternité. These continue to be breast-fed, and are kept till they attain a weight of about five kilograms. As I was not personally on the staff, I shall confine my remarks solely to the results obtained. Our last batch of weaklings was sent to the Pouponnière at the end of November 1897, and remained there till January 1, 1898. I left the Maternité about that time, to take up my duties at the Clinique Tarnier, so I have no later information.

What were the results from the point of view of the infants? What were the working expenses?

52 infants had been received at the Pouponnière. Of these, the history is known only till January 1, 1898; 9 died and 43 lived. Their mortality was therefore 17 per cent., which is exactly that of the full-term infants who were born at the Maternité and entrusted to breast wet-nurses. This rate is almost equal to the mortality of 15 per cent., among the weaklings who were discharged from the department in 1896, and confided to wet-nurses to be breast-fed.

What was the expense involved? This is an important consideration from a humanitarian point of view, for we must try to obtain the greatest possible return from all money consecrated to charity. The working expenses during 1897 were 2000 francs per month, 24,000 francs per year. As 43 children left in good health, each infant saved at the Pouponnière cost 558 francs, excluding the initial expenditure for building and furnishing. This is relatively a



large figure. A breast wet-nurse costs 40 francs per month, and an infant could be nourished for a whole year on the smaller sum of 480 francs.

There is still another interesting result from a social aspect. I have pointed out to you that an infant treated at the department for weaklings is separated from its mother. To save their lives is our primary concern, but afterwards, their mothers, no longer able to furnish the milk necessary to their nutrition, confide them to paid breast wet-nurses. I have been grieved to see a certain number of women come more and more rarely to visit their child, and gradually lose all interest in it. At length, when they were notified that it was about to be discharged, they made no response, and the infant, thus abandoned, I had to hand over to "Les Enfants Assistés." At the Pouponnière 12 out of these 43 infants, dismissed well, were abandoned—that is to say, 28 per cent. Their parents, hitherto freed from all worry and expense with regard to them, were now unwilling to assume their responsibility. I do not dare to say that desertion has thus been made easy, or that a school to encourage it has practically been created, but this figure, 28 per cent., is sad in the extreme.

This is the reason, gentlemen, why you have seen me insist so strongly in this Clinique on two points: first, save the infant, the essential point; second, save it in such a way that when it leaves the hospital it does so with a mother able to suckle it. So when a weakling has to be fed for a time by a wet-nurse I place a vigorous infant at the mother's breast. Her lacteal secretion is thus established. Soon she can nurse her own little one, and, on leaving the Clinique, will continue to suckle it. You can see at our Consultation infants, once weaklings—one of whom weighed only 1300 grams at birth—who are nursed by their mothers, and are doing well.

What afterwards becomes of weaklings thus saved? It has been alleged that they remain puny and weakly all their lives, that many of them have Little's disease, and that they have a feeble intellectual development.

That is not so. During my three years at the Maternité, out of 1100 admissions I saw only one case of Little's disease, and it was consequent on a difficult intervention in a pelvic presentation, and not due to debility.

Do these infants remain puny and weakly? I think not, unless they have some inherited disease. I know several who have attained

a certain number of years, and who in physical development cannot be distinguished from full-term children.

In 1877 I assisted at the birth of a premature girl infant. She was extremely difficult to save ; for a whole month she had to be kept in a room the temperature of which was maintained uniformly at 25° C. She has practically never had a day's illness, and has grown to more than average height and strength. This is only one of several similar cases I could cite to you.

As for intelligence, there is a little friend of mine who three days after birth weighed only 950 grams. She is seven years old, and speaks French and German.

I think that these allegations regarding the permanent bodily and mental debility of weaklings, and the frequency of Little's disease among them, are entirely without foundation. Nevertheless, everything ought to be done to ensure that an infant be born at term, well developed, and in a healthy condition. During pregnancy women must live under proper hygienic conditions, and avoid all fatigue. But in spite of every care infants are born prematurely, as the result of accidents, syphilis in the parents, and other causes. Are you to neglect the little weakling? Will you tell its mother it is far better not to try to rear it? Surely not. She will express in no uncertain fashion her wishes, especially if it be her first-born. She may not be free from fear lest this should be her only hope of being a mother. Experience will teach you that the more an infant is dependent on a mother's care the more she cherishes it, so no effort should be spared to save the little one ; and it can be saved. If the prematurity be due to an accident the infant is easy to rear. If, on the other hand, it be due to an inherited taint, such as syphilis, the task is much more difficult, although not impossible.

I showed you that here at the Clinique Tarnier during the year 1898, out of 30 infants born prematurely who weighed between 1500 and 2000 grams, 26 were saved, that is 87 per cent. ; out of 108 weighing between 2000 and 2500 grams, 101 were saved, or 93.5 per cent.

Among the latter there were 5 syphilitics : therefore out of 103 infants free from congenital taint only 2 died ; more than 98 per cent. survived. Therefore all that is humanly possible must be done on behalf of these little ones, and success will frequently attend your efforts.

There is one other point to be considered—has one the right to

provoke premature labour? Or should an infant always be allowed to go to full term, in order to give it the best chance of life, even although the mother must then incur the risks of operative interference? I believe the induction of premature labour to be absolutely legitimate.

In a recent paper Dubrisay has recorded the results of 8 cases of induction of premature labour. Seven infants left hospital in perfect health; 1 died of broncho-pneumonia three weeks after birth, but, as its initial weight was 3200 grams, its death could hardly be attributed to congenital debility arising from the premature labour.

In 1898, at the Clinique, here, I induced 7 premature labours; 7 infants and 7 mothers left the hospital living and well. This result was too good; I can scarcely expect again to have such fortune. I know how long and difficult such intervention often is, and how great are the risks to which the infant is exposed. Yet, considering the gravity of certain other operative procedures, such as symphysiotomy, which even in expert hands gives a mortality of 12 per cent. for mothers, and 13 per cent. for infants, and Cæsarean section, which, although varying in fatality according to different authors, gives on an average a death-rate of 10 per cent., I do not think we are justified in discarding induction. As the mother's existence is generally not compromised, and the result is usually a living child, it seems to me to be a most valuable method of obstetrical intervention. Further, infants thus brought into the world before term are often not weaklings; among my 7 cases only 2 could be considered as congenitally feeble, 1 of which weighed 2110 and the other 2290 grams. The remaining 5 weighed 2800 grams or more (Appendix).

Having measured the pelvis as accurately as possible, and then estimated the diameters of the foetal head by Perret's method, I waited till I found that the continuation of the pregnancy involved risk to the mother. Then, and not till then, did I induce labour.

In conclusion, gentlemen, when you are called to a weakling do your utmost to save it, and bear in mind three things in particular:—

1. Strive to prevent the weakling becoming cold, as a fall of temperature may prove fatal.
2. Carefully supervise its feeding; underfeeding means inanition and attacks of cyanosis; overfeeding, digestive troubles and diarrhoea. I have indicated to you how the quantities of milk are to be regulated according to the weight of the child.
3. Avoid absolutely all exposure to contagious affections.

If you take these precautions, and especially if the weakling has a good wet-nurse who, by also nursing her own child, conserves her supply of milk, or, better still, if the weakling be nourished by its own mother, in whom the mammary secretion has been established by one of the methods I have outlined, you will have the satisfaction of succeeding in the same proportion of cases as I have done. And surely my results are full of hope and encouragement.

## LECTURE V

SUMMARY :—Full-term infants—Their feeding during the first ten days—Use of the balance—Importance of weighing—Value of weight-charts—Variations in weight during the first ten days—First diminution, then augmentation.

Underfed infants—Mothers who do not yield sufficient milk—Infants with congenital malformations which prevent sucking.

Mother's supply at first inadequate—Compensation by asses' or cows' milk—Digestive disturbances in oversuckled infants—How to regulate breast-feeding—Mastitis, sore throat, &c., in mother—Effect on nursling—Affections of nurslings—Coryza, thrush, bronchitis—Infants who continue throughout febrile diseases to increase in weight—Abrupt and considerable increase in infants about to die.

GENTLEMEN,

Hitherto we have been considering the congenitally feeble infant ; to-day I shall speak to you of the infant born at term. And I shall discuss chiefly its feeding in the first ten, twelve, or fifteen days of life, during which, perhaps, it remains with its mother in a maternity hospital.

An infant, according to researches published by Bouchaud in 1864, during the first twenty-four hours takes practically nothing when put to the breast. The first day it ingests, maybe, less than 30 grams of milk ; the second, a little more than 150 ; the third, 400 ; the fourth and fifth, 550 ; and then, almost 600 grams. Some, however, take rather more at the beginning ; these are mainly well-developed infants born of multiparous mothers, whose mammary secretion becomes quickly established, or infants to whom a wet-nurse has been given immediately after birth.

On the first day an infant generally takes nothing. If he cries before the mother is able to minister to his wants, a few spoonfuls of sterilised milk and water, slightly sugared, may be given to him, but syrups and similar fluids must be avoided.

When the milk function is fully established the mother should feed the infant with a certain regularity ; every two hours during the day and twice during the night is a good rule. In this way he will have eight to ten meals in twenty-four hours. Here, at the Clinique, I demand great exactitude from the staff in this particular. I have made a small chart, on which are noted the hours of the



meals, and the quantity and source of the milk taken by the infant ; by this means the total can be easily ascertained (see Appendix).

The newly born ought seldom to remain at the breast longer than ten minutes, or at most fifteen. Too long a stay is undesirable both for mother and infant. The nipple, by remaining long in the mouth of the child, becomes macerated ; fissures and cracks may then appear, which are not only painful, but pave the way for more serious affections of the breast. On the other hand, if too much milk is ingested, the infant acquires digestive troubles, vomiting, colic, and diarrhœa.

That we may follow exactly the changes which take place in its general state, the infant must be weighed. Only the balance will enable us to determine with certainty its augmentation or diminution, the sufficiency or otherwise of its diet.

An ordinary balance may be used, but for greater convenience one of the scales is usually replaced by a small cloth hammock supported by metal rods, or by a small wicker cradle fixed by wires to the steel bars destined to receive the scales. Many kinds are sold specially constructed for infant-weighing, and are called "baby scales."

An infant may be weighed naked, but certain precautions are then necessary to guard against cold. This small operation is generally performed when the baby has just been bathed ; having been dried with a warm towel, and wrapped in flannel, it is put on the balance. From the figure obtained we need only subtract the weight of the flannel in order to know that of the infant. If, for example, the baby in flannel weighs 3350 grams, and the flannel alone 350 grams, the baby's weight is, of course, 3000 grams.

For several years I have used charts on which to record the infant's weight. If all the figures within the probable range were to be printed on the chart, it would be either too large to be easily handled, or, if the chart were reduced to a convenient size, the variations of the curve would be so small as to be almost imperceptible. My charts are of a uniform and manageable size, 36 cm. long and 26 cm. broad (Fig. 44). The space between each of the fine horizontal lines represents a difference of 5 grams ; before the lines of medium thickness are placed the figures 25, 50, 75 ; and heavy lines indicate the hundreds. As the latter on the printed chart are represented by zeros only, we have at our disposal a sort of movable scale. It is necessary only to place before the

zeros the figures representing in hundreds the weight in grams at birth. If, for example, the infant weighs 3500 grams, 35 is written before the two zeros. As the length of the chart allows a difference of 600 grams, there is generally sufficient scope to record all the variations which may arise during a stay in hospital of twenty days.

During the first two or three days subsequent to birth the infant loses weight. The amount varies, but on an average it equals 150 to 200 grams. This is due to the evacuation of meconium and urine, exhalation from the lungs, and perspiration. But the infant, being fed, begins to augment; towards the seventh day he has regained what he had lost; and on the tenth he weighs 100 grams more than he did at birth.

In some rare cases the infant seems not to lose, or to lose but little. This occurs when he has voided urine and meconium during delivery, which often happens, for example, in pelvic presentations; or when the infant, immediately after birth, is suckled by a wet-nurse or a multiparous mother with abundance of milk.

The use of the balance is of the greatest service in detecting whether an infant is taking insufficient or excessive quantities of milk. Certain nurslings, when they are underfed, cease to cry, and fall into a state of torpor which is easily mistaken for tranquillity. They pass but little urine; they are constipated, or rather their motions are rare; they are almost constantly asleep; they linger long at the breast when being fed; but although they appear to perform the suction movements necessary, on close observation they are seen not to be swallowing at all. On December 26, 1891, just as I was leaving Paris for several weeks, I assisted at the birth of a large boy who weighed 4500 grams. The father, who had to keep me informed of the child's progress, wrote that his son appeared to be doing well, but, strange to relate, was almost always sleeping. I telegraphed to weigh him at once and tell me the result. He had diminished enormously. My orders to weigh him every morning had been neglected by the nurse. The mother had practically no milk, and no one had sought to find if he were getting enough. On each insufficient maternal feed being supplemented with cows' milk, the baby quickly regained the weight lost (Fig. 45).

If the real situation be not recognised, the infant, through want of food, soon dies. If we wait too long it becomes incapable of

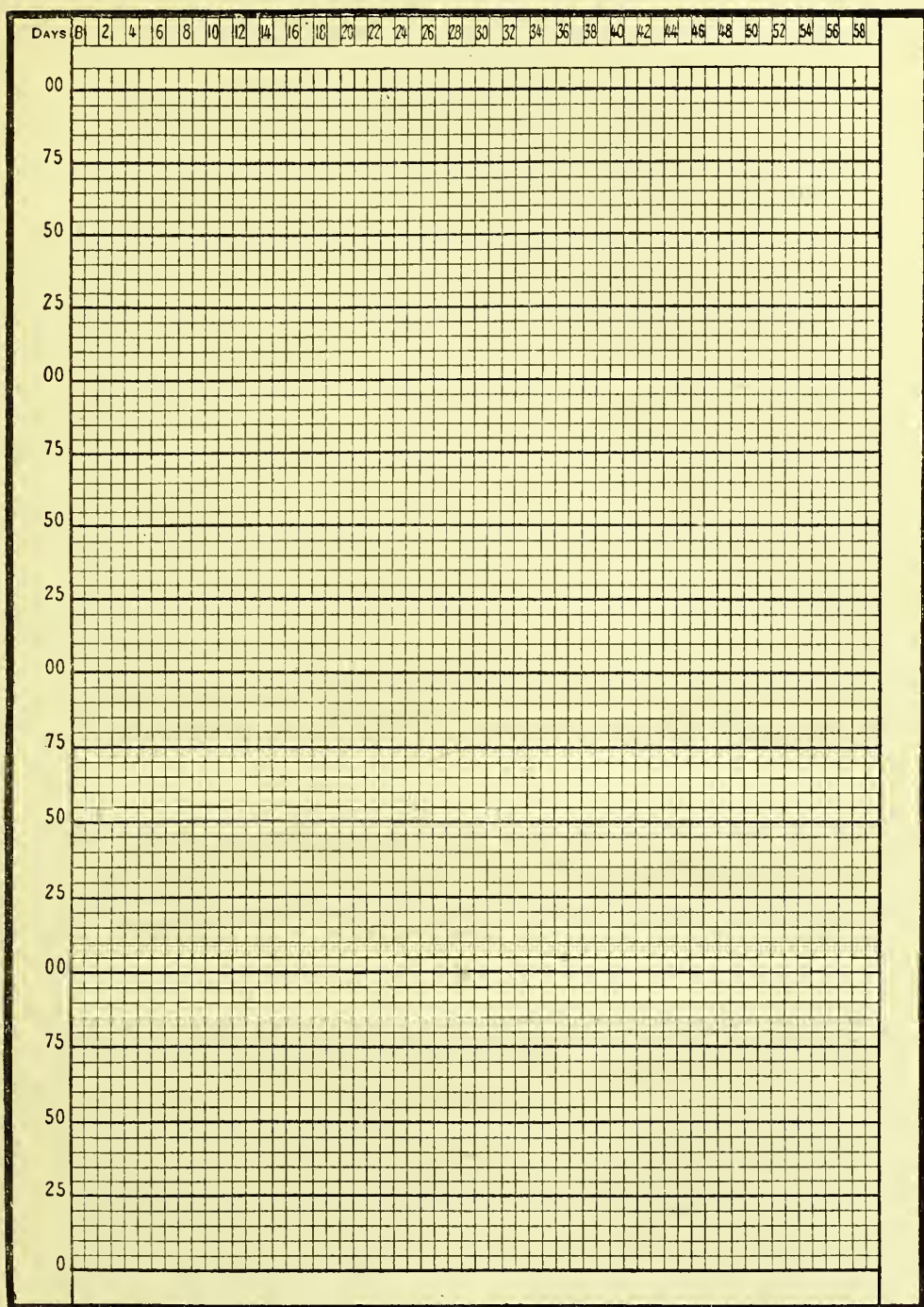


FIG. 44.—Chart with movable scale on which graphically to record the weight of an infant.



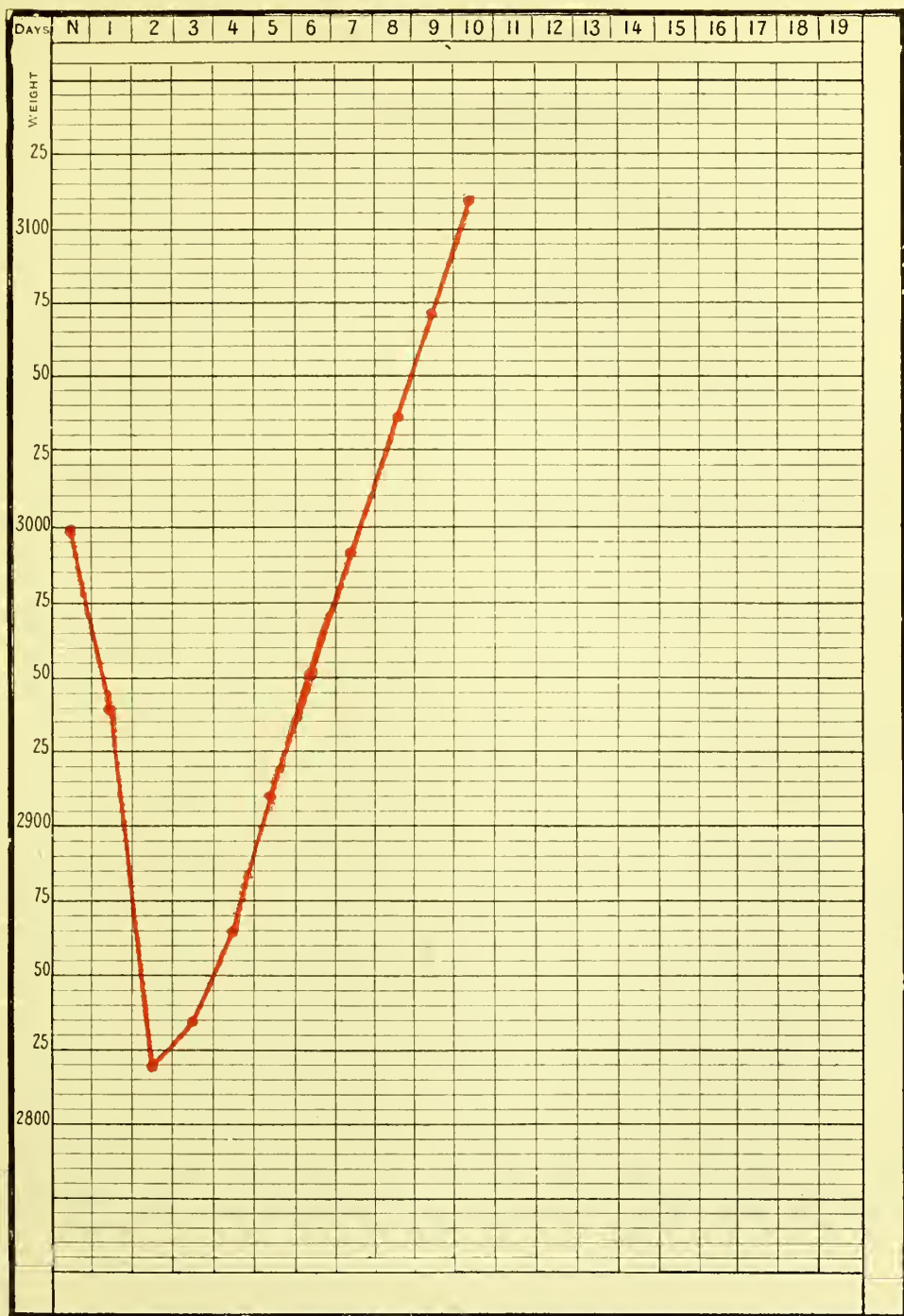


FIG. 45.—Normal curve of an infant's weight during the first ten days of life.





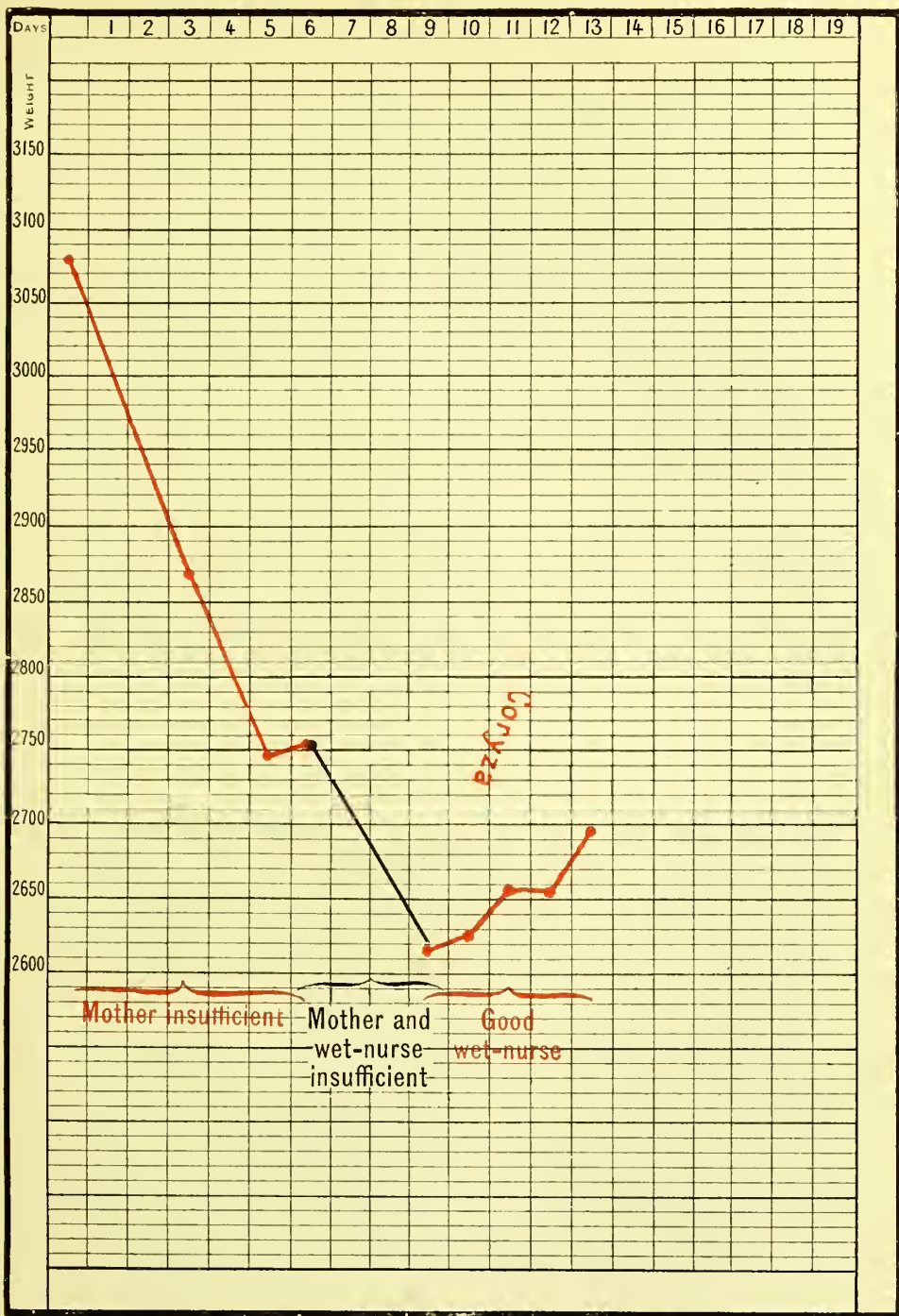


FIG. 46.—Curve of an infant showing great loss of weight, due to under-feeding. The total supply of mother and wet-nurse was insufficient.





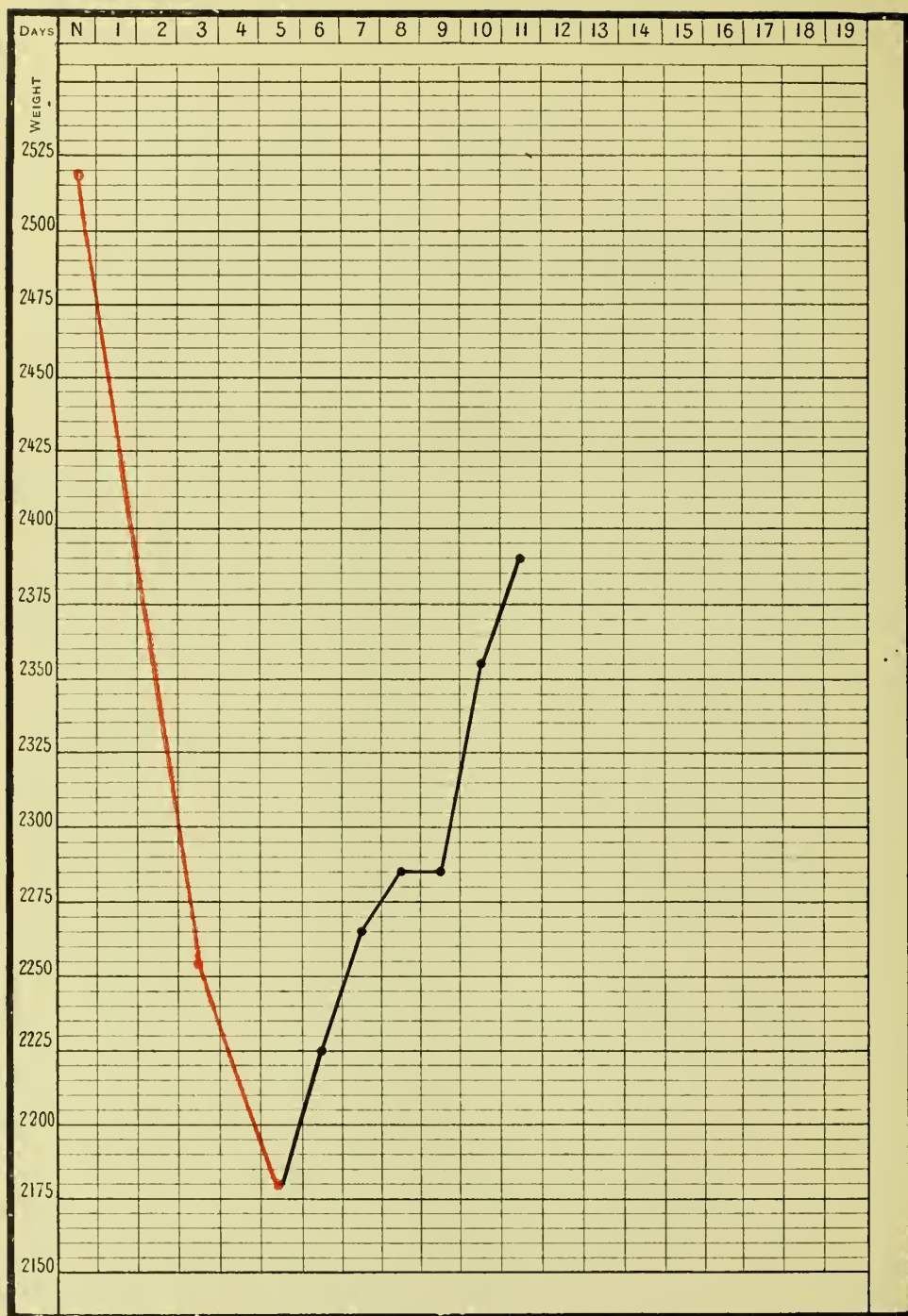


FIG. 47.—Mother unwilling to suckle. Result of constant supervision from the fifth day.



swallowing even from a spoon. It must then be regarded and cared for as a weakling. It should be rubbed and massaged, put into an incubator to avoid cold, and fed by gavage. Under proper treatment the weight ceases to diminish, the infant begins to swallow, and, finally, is able to suck.

I have already had occasion to publish cases of this kind. Here, for example, is the curve of an infant Augustine S——, born in the Clinique on December 3, 1887, with a weight of 3080 grams (Fig. 46). On the fifth day it had fallen to 2790 grams. By weighing the child before and after each meal we found that the mother was furnishing very little milk. She was therefore supplemented by a wet-nurse, but the diminution continued. On the eighth day its weight was taken before and after each occasion on which it was put to the breasts of the mother and wet-nurse; it was then discovered that in twenty-four hours, each gave him 100 grams, which was a daily ration of only 200 grams. By the morning of the ninth day it weighed only 2620 grams, and was no longer able to swallow. A good wet-nurse was chosen; she commenced by drawing off her milk and feeding him by gavage. On the tenth day he gained 10 grams and on the eleventh 30 grams. He began to suck again, and his weight steadily increased.

Sometimes a mother is unwilling, although quite able, to nurse her infant. For example, on December 3, 1887, a woman, named Adele F——, gave birth here to a boy weighing 2520 grams. On the fifth day he weighed only 2180 grams. I recommended that he be put to the breast every two hours, and that the mother be watched day and night. As on the sixth day he weighed 2225 grams, on the seventh 2265, on the eighth 2285, and on the eleventh 2390, the influence of incessant supervision of the maternal feeding was a gain of 210 grams in six days, or an average of 35 grams per day (Fig. 47).

Still more conclusive was the case of the infant Go——, who weighed 3550 grams at birth (Fig. 48). The second day it had lost 50 grams. Then it rapidly increased, and reached 3690 on the fifth day. On the seventh its weight was only 3630 grams; the diminution continued on the eighth, and it was then discovered that the mother, a woman of small intelligence, did not wish to rear the child. She was supervised, and on the ninth day the infant increased 20 grams; as on the tenth it diminished again, I demanded an explanation from the nurse in charge of the case.

She confessed she had been too busy to keep proper watch, but promised to do so faithfully in future. On the eleventh day the infant weighed 3610 grams, on the twelfth 3650, and, the supervision being again neglected, on the thirteenth day the weight remained stationary. As I stimulated anew the zeal of the staff, its weight rose to 3690 grams by the fourteenth day, 3750 by the fifteenth, and 3810 by the sixteenth, an increase of 160 grams in three days.

The balance must therefore be used as a control for the feeding.

Some newly-born infants will not suck, and others cannot. You saw an infant recently who, born at full term and with a normal weight, absolutely refused to be suckled either by mother or by wet-nurse. As it would not swallow the milk even from a spoon, it had to be gavaged. After several days it unbent so far as to drink from a glass, and at the end of twelve days consented to suck. It left the hospital in perfect health fed by its mother.

You have just seen another case equally interesting, in which the infant seemed to have a normal conformation. Put to the breast, he appeared to suck, and yet his weight did not increase. On weighing him before and after meals, to my great surprise, I found he was taking absolutely nothing. He was given a good wet-nurse, but with the same result. Then his mouth was carefully examined; his lips were well formed, he was quite a pretty infant, but he had a cleft palate which had never been suspected and which rendered sucking impossible. He was suitably fed, and soon began to thrive.

There are other infants who, although taking a normal quantity, do not increase in weight, for they do not assimilate what they ingest. In these circumstances, which are far from rare, the administration of a small quantity of pepsin makes the curve rise steadily.

It sometimes happens that the infant does not augment because, at the beginning, the mother does not yield the amount of milk sufficient for his needs. If her supply is supplemented the mother, unaided, will after a time furnish enough to satisfy his wants.

On February 13, 1888, I delivered a doctor's wife of a baby boy who weighed 3250 grams (Fig. 49). On the third day he took 218 grams of milk from the mother's breast, the fourth 220 grams,

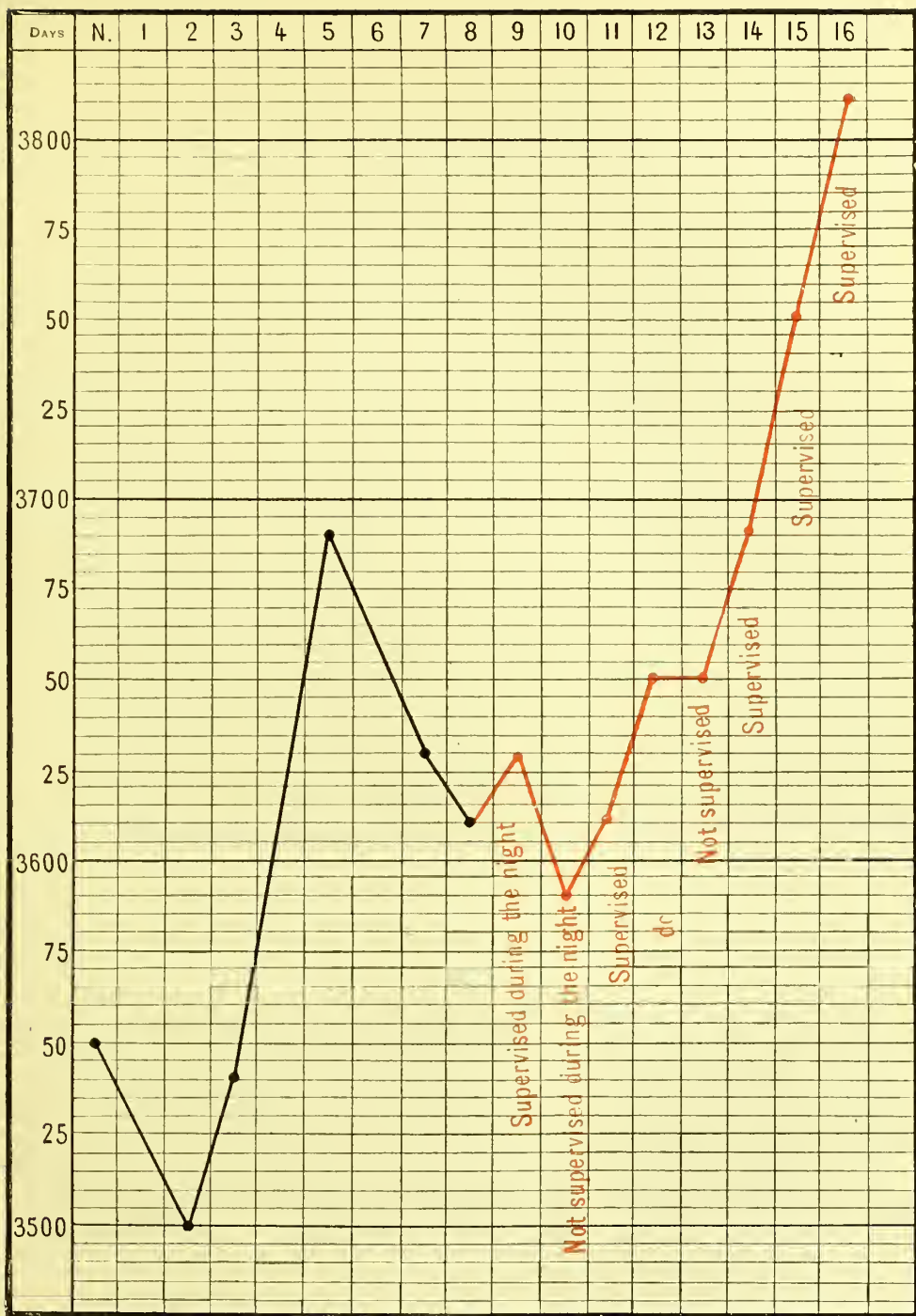


FIG. 48. -- Mother who did not wish to nurse. Effect of intermittent supervision.







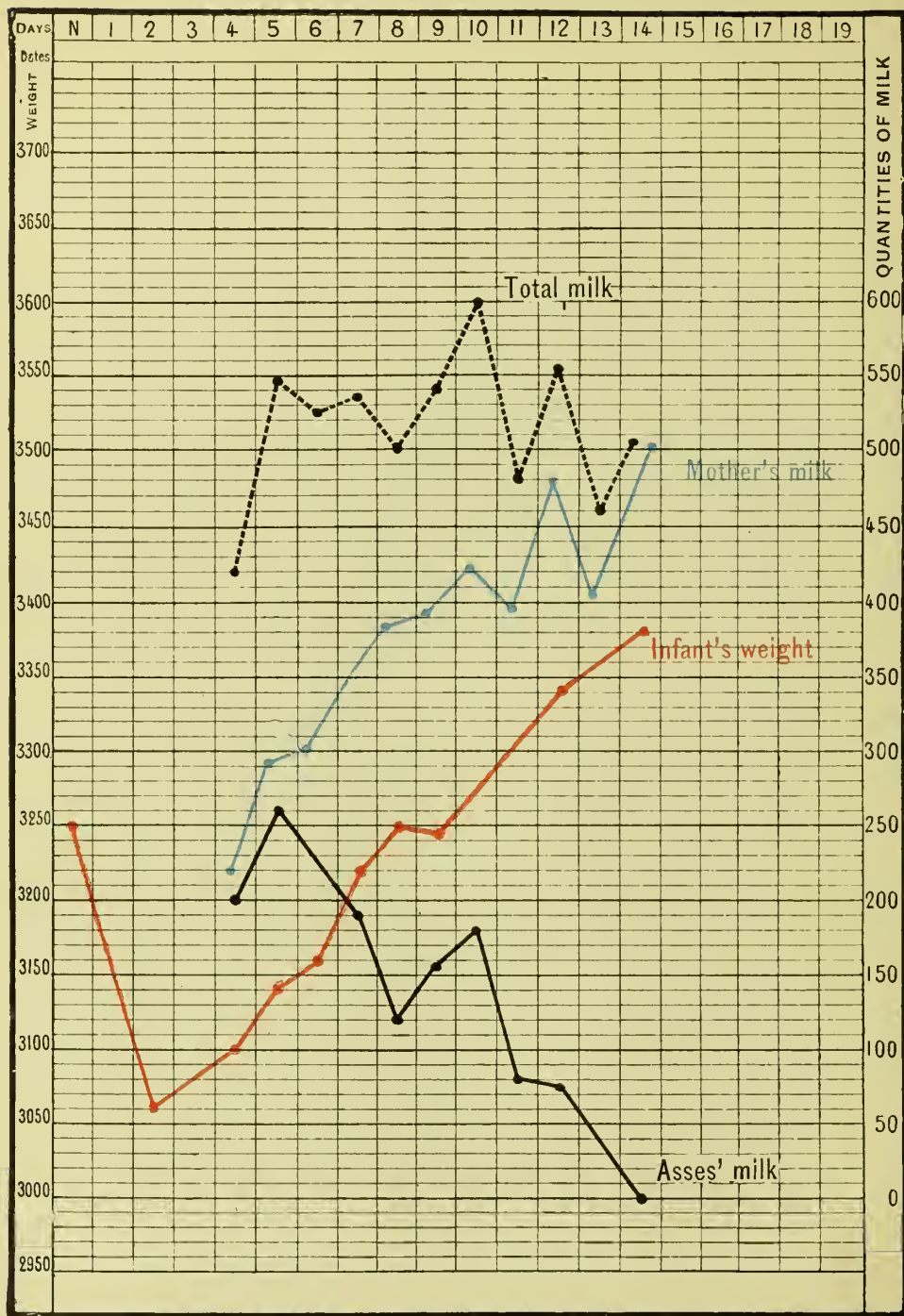


FIG. 49. Maternal feeding inadequate at first. Mother's efforts temporarily aided by asses' milk. Red, infant's weight; blue, mother's milk; black, asses' milk. Interrupted black line, total of the two milks.

which was supplemented by 202 grams of asses' milk; on the subsequent days the figures were—

Day.	Maternal Milk.	Asses' Milk.	Total.
5th . . .	288 grams	+ 258 grams	= 546 grams.
6th . . .	299 "	+ 226 "	= 525 "
7th . . .	346 "	+ 189 "	= 535 "
8th . . .	382 "	+ 118 "	= 500 "
9th . . .	387 "	+ 155 "	= 542 "
10th . . .	423 "	+ 180 "	= 603 "
11th . . .	397 "	+ 80 "	= 477 "
12th . . .	482 "	+ 75 "	= 557 "
13th . . .	411 "	+ 40 "	= 451 "
14th . . .	504 "	+ 0 "	= 504 "

If, ignoring the details, we study the curve as a whole, we see that in proportion as the quantity of the maternal milk increases the asses' milk was diminished, till on the fourteenth day the former had attained 504 grams and the latter zero. During this time the infant's weight followed practically the normal curve; after an initial loss of 190 grams, which he regained on the ninth day, he reached 3380 grams on the fourteenth day, after which the mother alone sufficed for the feeding.

On June 11, 1898, I delivered a patient of a full-term infant which weighed 3490 grams (Fig. 50). On June 12 the mother's breasts were swollen, hard, and very painful, but the infant, when put to them, could obtain no milk. This lasted till June 16. The infant was meantime given 100, 150, 300, and 400 grams of sterilised cows' milk, as is shown on the curve. On June 16 the breasts, being softer and less painful, yielded 80 grams in the twenty-four hours. This amount gradually increased and the supply of cows' milk was correspondingly reduced.

Date.	Mother's Milk.	Cows' Milk.
June 16 . . . . .	80 grams	360 grams.
" 17 . . . . .	140 "	225 "
" 18 . . . . .	180 "	225 "
" 19 . . . . .	230 "	215 "
" 20 . . . . .	240 "	225 "
" 21 . . . . .	340 "	185 "
" 22 . . . . .	395 "	200 "
" 23 . . . . .	315 "	150 "
" 24 . . . . .	460 "	150 "

As the infant, who had fallen to 3450 grams on June 14, reached 3800 grams on June 24, an increase of 350 grams in ten

days, or an average increase every day of 35 grams, had taken place. Not till July 14, however, was the mother able adequately to fulfil her function as nurse. Thus, a mother who has no milk at the beginning may ultimately be able to suckle her child. Even after five or six days one must not despair. Her own infant or, if practicable, a strong and vigorous substitute, should continue regularly to be put to her breast. After a certain time the milk will flow, at first in small quantities, and then more abundantly, until an excellent supply may be forthcoming.

Sometimes, on the other hand, it is the very abundance of the mother's milk which is the source of trouble. The infant drinks gluttonously and ingests enormous quantities of milk; it micturates almost constantly, the motions are frequent, and the weight augments in exaggerated proportions. Soon, however, this increase stops, and colic, diarrhoea, and other symptoms of digestive trouble make their appearance.

Here is an instance I recorded eleven years ago. A woman, Car——, gave birth to a boy weighing 3570 grams (Fig. 51). As the mother had plenty of milk, the infant weighed on the second day 3640 grams, and continued to increase in an almost incredible fashion: on the fourth day he was 3740 grams; on the fifth, 3900; on the seventh, 4000; on the eighth, 4170; on the tenth, 4280. Since birth he had augmented 720 grams, which was an average gain of 72 grams per day. Not without misgiving did I watch his fantastic curve. The balance showed that this infant was taking at each meal 100, 150, and even 160 grams of milk. From the tenth to the twelfth day he had diarrhoea, and increased only 40 grams, and on the thirteenth he lost 10 grams. On the fourteenth day he left hospital. Following my advice, the mother fed her baby regularly every two hours, and before putting it to the breast expressed the aqueous milk which had accumulated in the mammary ducts. The infant thus received milk less in amount but more nutritive in quality.

Not only must the quantity of an infant's meal be regulated, but also the hours at which it is fed. On January 3, 1899, a woman, G——, was delivered of a boy who weighed 2550 grams (Fig. 52). He had the usual fall in weight, and then began to augment. In spite of our remonstrances the mother put him to the breast every moment of the day and night, with the inevitable digestive disturbances. After gaining 50, 20, and then 15 grams per day he became stationary. Diarrhoea followed, and his weight

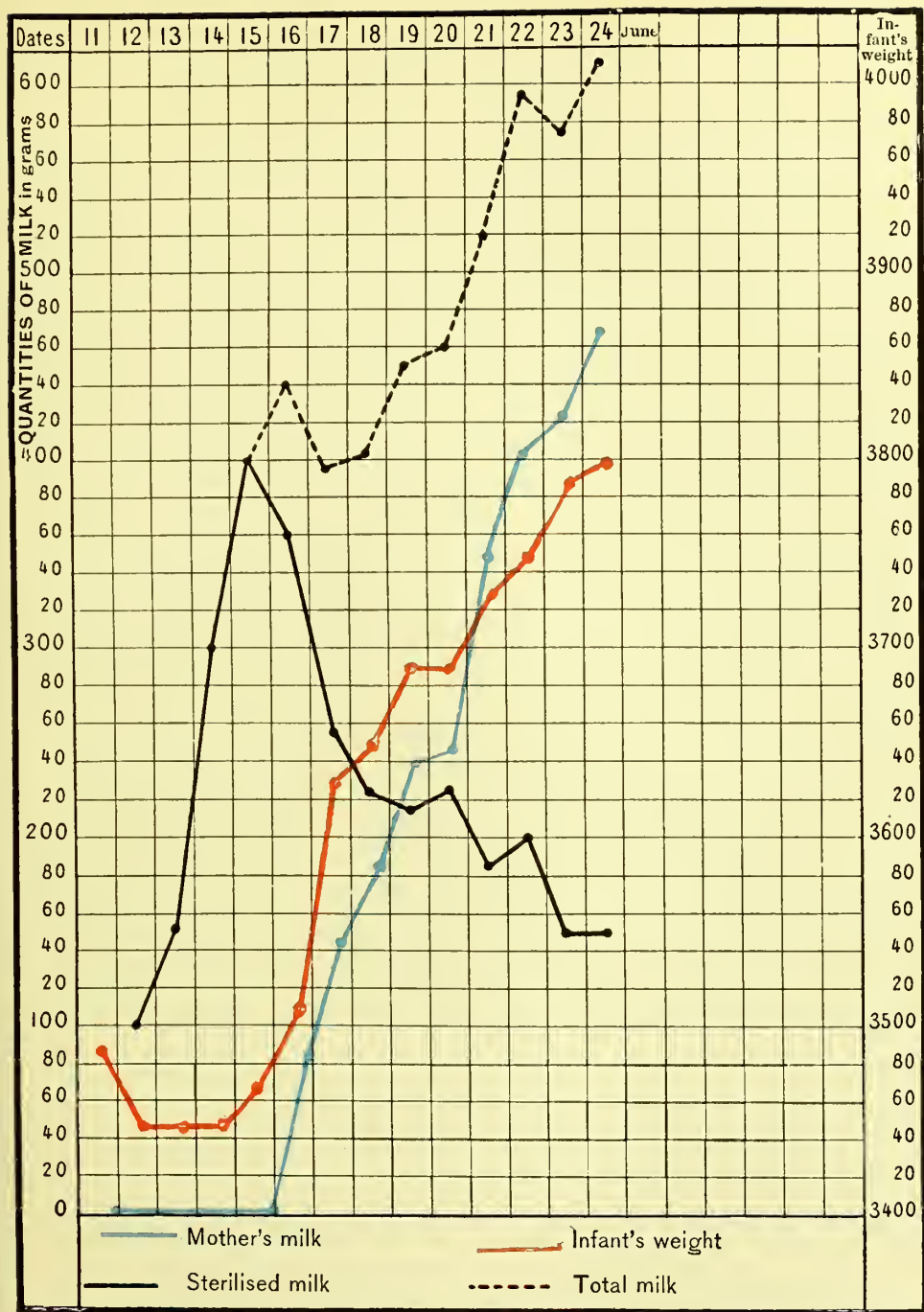


FIG. 50.—Maternal milk did not appear till between the fifth and sixth days. Sterilised cows' milk was used first as a substitute, then as a supplement.







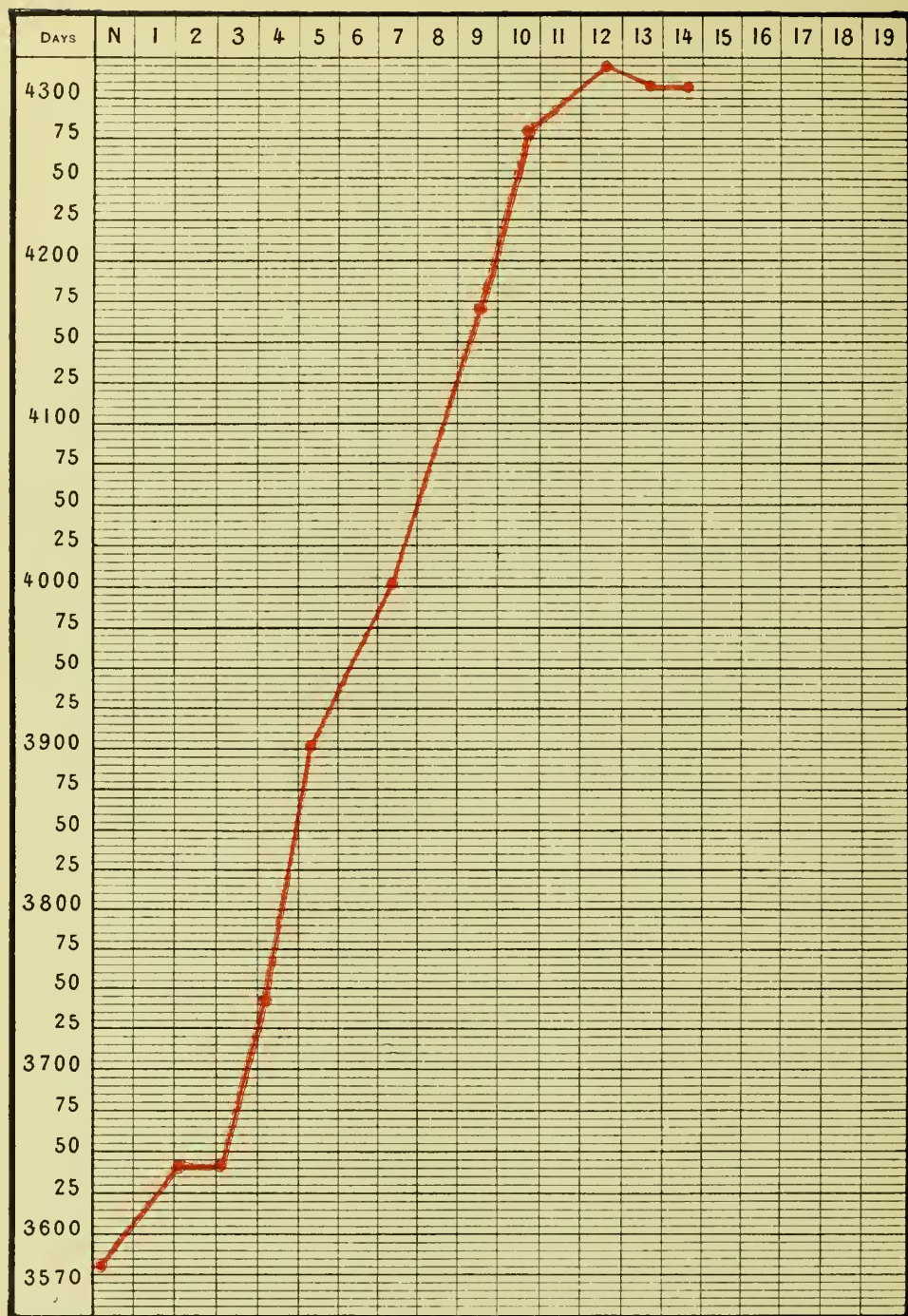


FIG. 51.—Infant who took too much milk. His weight increased considerably, but he had digestive troubles.

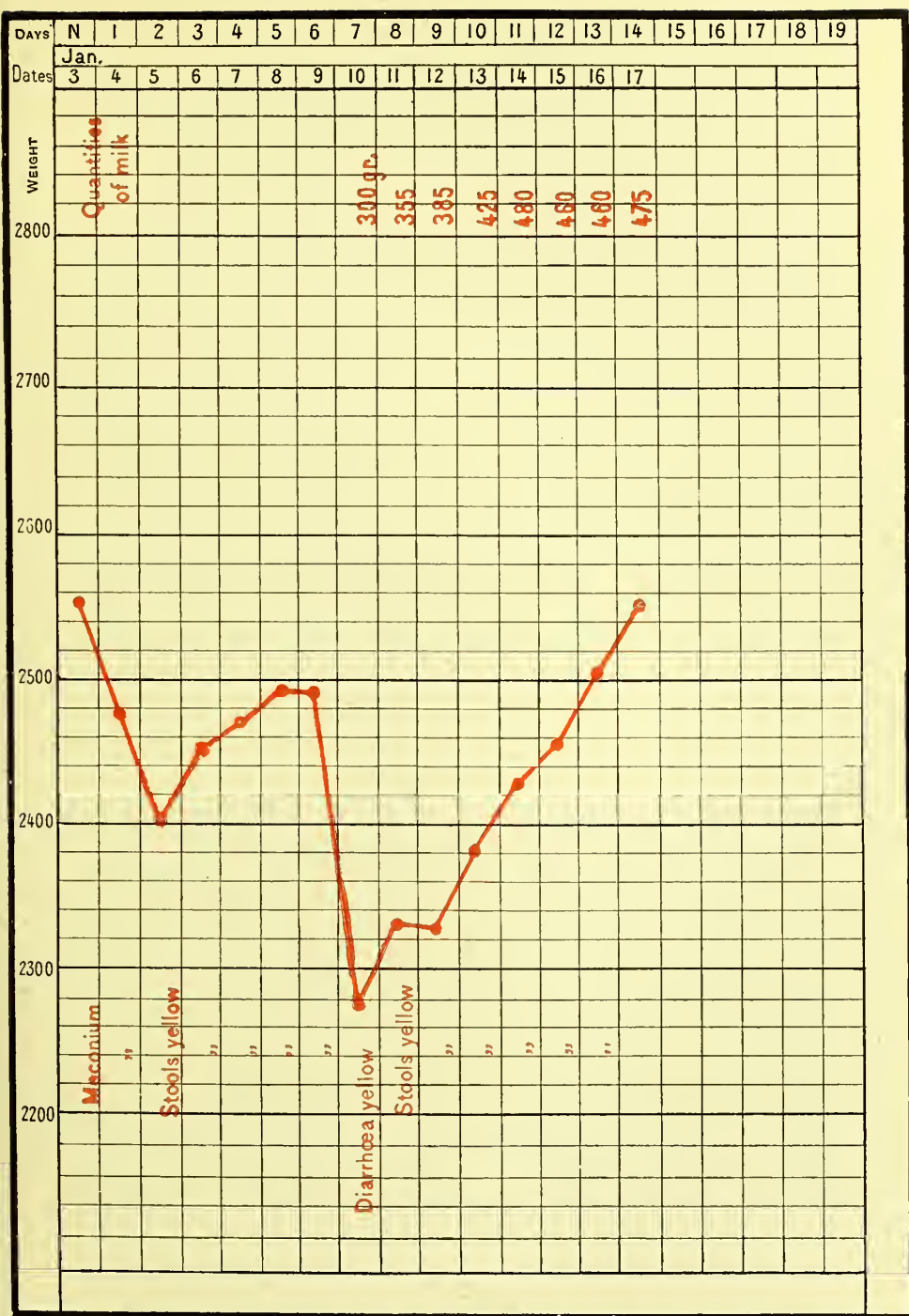


FIG. 52.—Digestive troubles and loss of weight due to feeding at irregular intervals. The infant recovered, and began to thrive when the feeding was rigorously regulated.







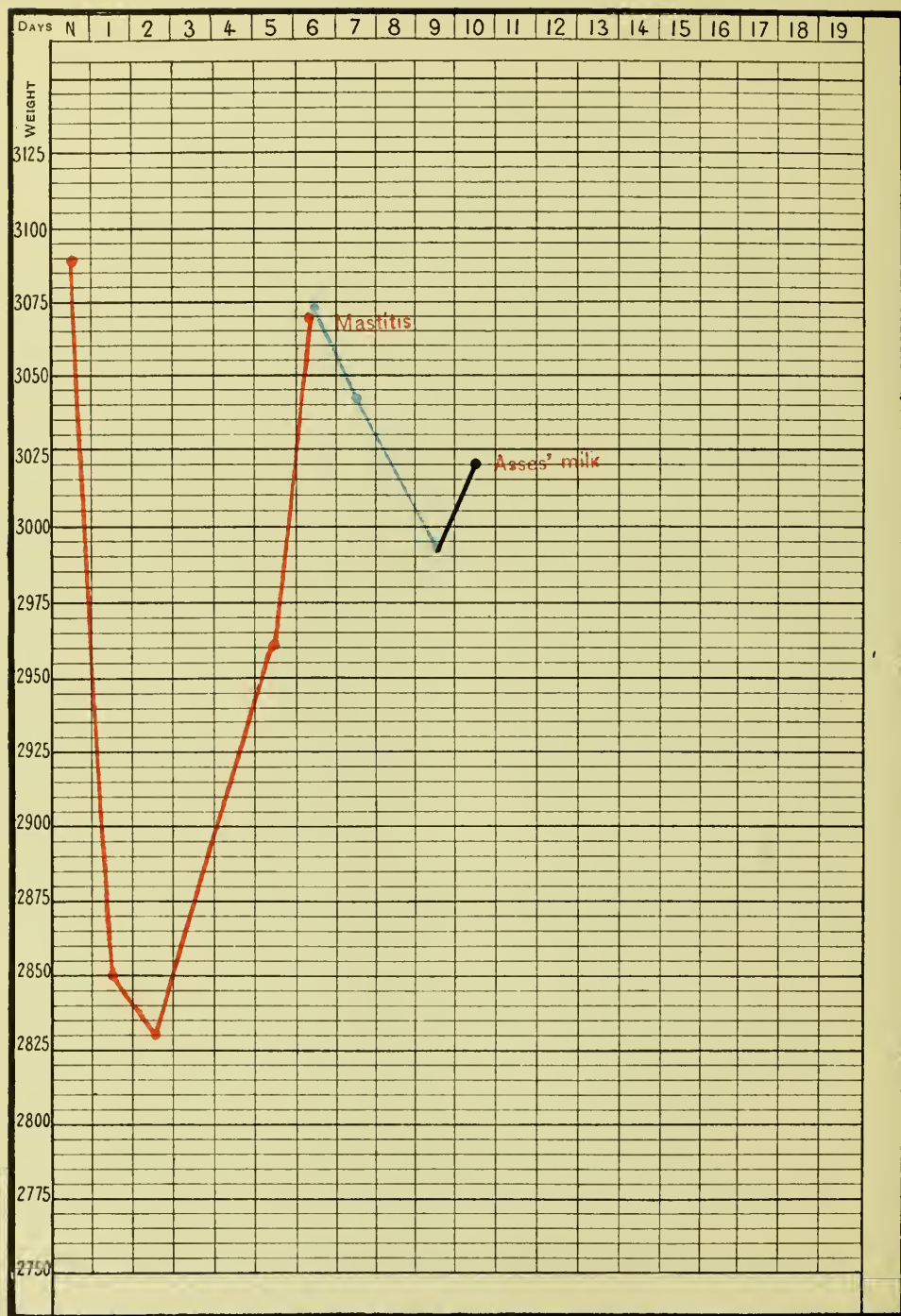


FIG. 53.—Mother had mastitis; infant lost weight.

of 2485 grams became 2275. He was taken from his mother and carefully dieted. On January 10 she was allowed to give him only 300 grams; 11th, 355; 12th, 385; 13th, 425; 14th, 480; and 15th, 460. He quickly recovered, his stools became yellow again, and he rose from 2275 to 2545 grams between January 10 and 17.

In case of illness of either mother or child most minute attention must be paid to the latter. The woman, Sch——, was delivered of a daughter on February 21, 1888, who weighed 3090 grams (Fig. 53). On the sixth day she was 3070 grams, and had thus nearly regained her initial weight. As the mother was then attacked by mastitis, the infant steadily lost weight, till on the ninth day she was only 2990 grams. Asses' milk was given, and the curve rose once more.

Besides breast troubles, mothers not infrequently have sore throat, bronchitis, influenza, and other acute affections of short duration. The milk may then be produced in smaller quantity, or its quality may be modified. The balance may show that the infant no longer gains, and it may even lose weight. Without interrupting the maternal feeding, precautions should be taken to guard the infant from the passing malady of the mother, and, if its nutrition becomes insufficient, mixed feeding may be temporarily practised.

If the infant be ill, its weight rapidly diminishes, especially if the affection gives rise to interference with sucking or swallowing. The infant So—— was born on February 18, 1888, with a weight of 2370 grams (Fig. 54). Having gained 80 grams by the sixth day, it was seized with coryza, and, in spite of our care, decreased considerably in weight. On the fourteenth day it was only 2170 grams, and had to be gaviged.

Thrush also causes much loss of weight, perhaps because sucking gives the infant pain. Baby Bron——, born on February 15, 1888, weighed 3560 grams (Fig. 55). On the ninth day it took thrush, and lost 170 grams in four days. Once cured and able to suck freely again, it soon regained what it had lost. In these cases, where the infant ceases to take sufficient nourishment at the breast, you must feed it by glass or spoon, or even by gavage.

Most febrile pathological states in infants are accompanied by loss of weight. A little girl born in hospital on January 4, 1888, had reached on the ninth day a weight of 3350 grams. She then took bronchitis, and on the fourteenth day her weight was 3250

grams. Although cured when she left on the twentieth day, she was still only 3230 grams.

However, it is not always thus: infants may be ill, even very seriously ill, and yet continue to increase in weight. As far back as 1888 I wrote as follows: "Infants attacked with inflammation in the region of the umbilicus usually lose weight, but, curious to relate, when well fed they may continue to gain slightly, although they may be dying from septic infection;" and later, in my book for midwives, I said: "In cases of inflammation in the neighbourhood of the umbilicus, and even sometimes in bronchitis, the weight may be seen to increase persistently till death."

You have lately seen two cases of this kind. One was an infant, No. 1560, born on November 17, 1898, with a weight of 3040 grams, who lived in the wards for many months. On January 1, 1899, he weighed 4300 grams. On January 2 he began to cough; on the 3rd fine crepitations were heard in his chest; on the 4th his rectal temperature was 38° C.; and on the 5th he presented all the symptoms of broncho-pneumonia. On this date he weighed 4075 grams; his temperature remained high; yet on the 6th he was 4125 grams, and on the 7th, 4170. His weight fell to 4065 grams, and then continued to rise, although the affection did not improve for eight days (Fig. 55).

Baby René X—— (No. 1612), born on November 28, 1898, weighed 3400 grams. On the ninth day, December 7, having just regained his initial weight, he developed a lymphangitis in the neighbourhood of the umbilicus. His temperature rose to 38° C. on the 12th, and 39° C. on the 15th; extensive ulceration took place, and yet his weight was not greatly affected. On December 8 he remained stationary; on the 9th there was a loss of 60 grams; but thenceforth, increasing daily, he attained on the 17th, 3655 grams. There was thus an increase of 315 grams in eight days, and an average gain per day of 39 grams.

The regular and progressive increase in weight of a newly-born infant is of great importance, but it must not be considered to have an absolute significance. In this connection let me point out to you an interesting fact. In the Maternité in 1895 I noticed that not only might dying infants increase till the last, but some of them, for two or three days previous to the end, or even on the very day of death, show an abrupt and considerable augmentation in weight. Generally in these cases no more milk is absorbed than the infant has been accustomed to take; but on the other hand the urine



FIG. 54.—Coryza. Loss of weight owing to interference with sucking.





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FIG. 55.—“Thrush” (*muguet*). Loss of weight owing to the pain of sucking.

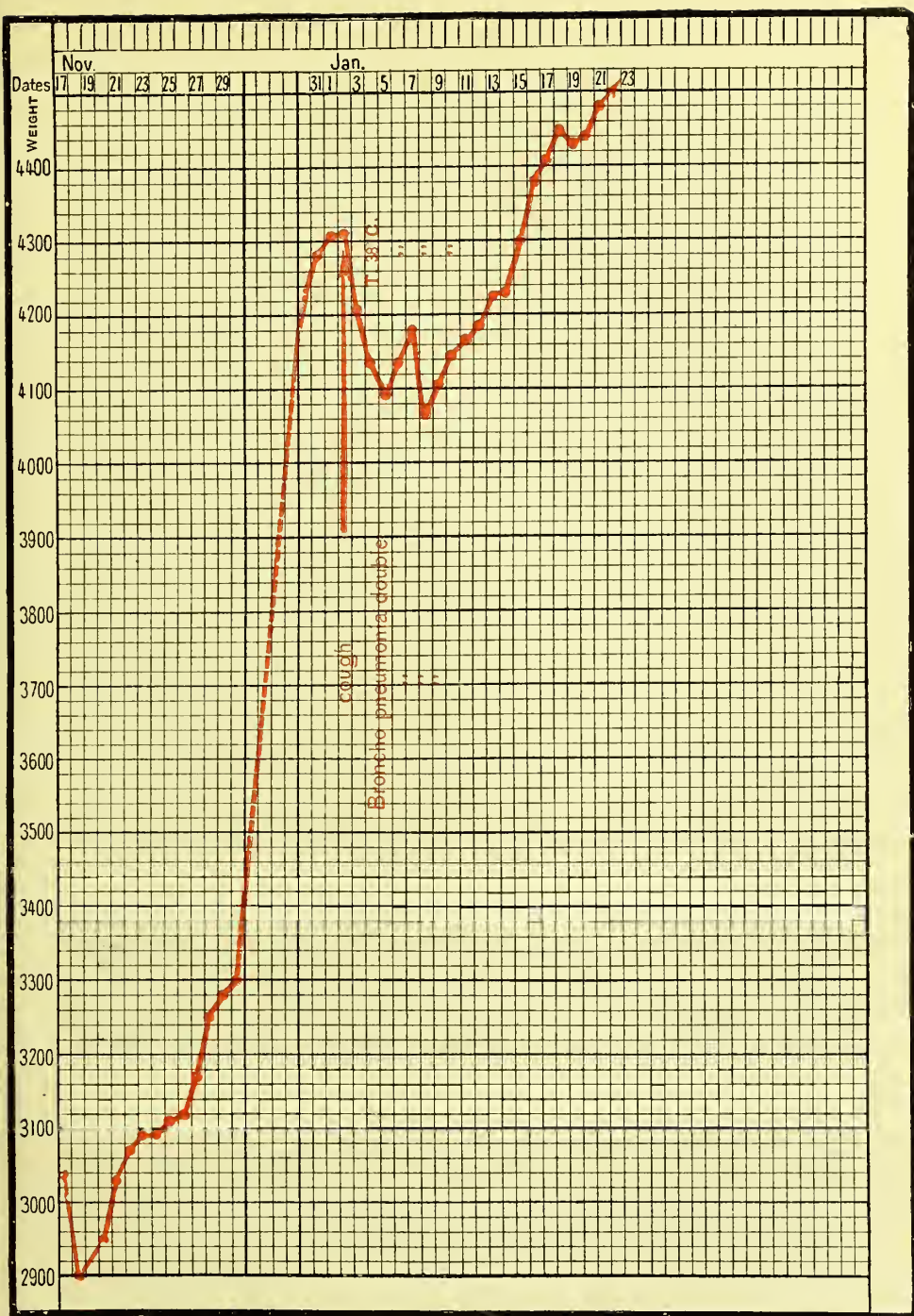


FIG. 56.—Weight increasing in the presence of broncho-pneumonia.







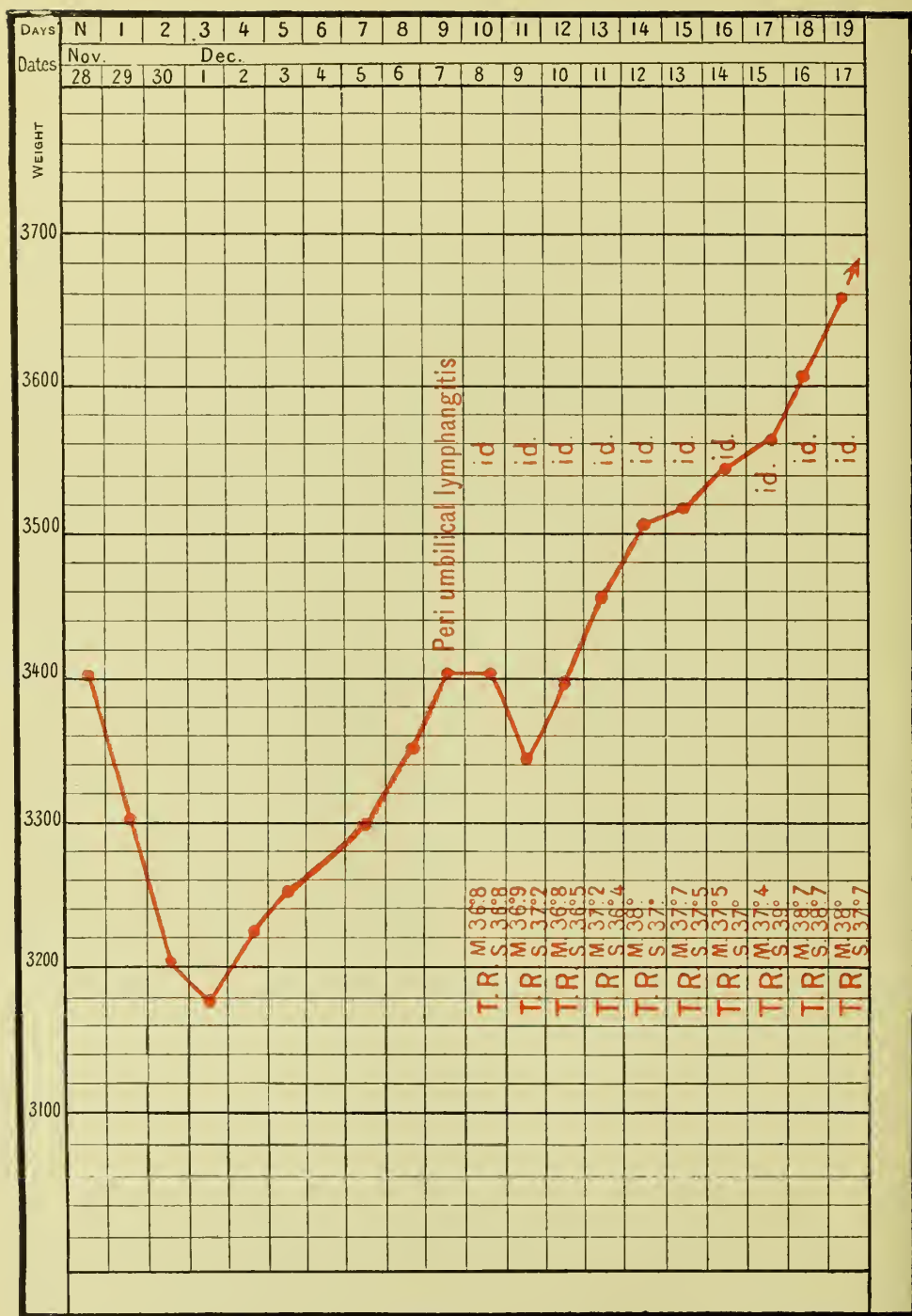


FIG. 57.—Persistent increase of weight during the course of an inflammatory process around the umbilicus.

diminishes greatly in amount and a partial or generalised œdema develops.

Baby El—— H—— (No. 366), born on November 4, 1895, was brought to the Maternité weighing 1990 grams and with a rectal temperature of only 32° C. He progressed slowly, and on November 30 he weighed only 2110 grams. On December 2 he took influenzal coryza and diminished slightly: on December 18 he weighed 1930 grams, when suddenly he began to increase remarkably.

On December 19 his weight was 2025 grams.

"	"	20	"	"	2100	"
"	"	21	"	"	2160	"

In three days he had increased 230 grams. There was œdema of the right foot. His temperature remained normal till the day he died, when it suddenly rose to 40.6° C.

The quantities of milk taken in the last days were: December 14, 510 grams; 15th, 490; 16th, 580; 17th, 635; 18th, 600; 19th, 530; and 20th, 495 grams. In the forty-eight hours preceding death, therefore, there was no increase in the amount ingested.

The infant Gabriel G——, born on September 24, 1895, was brought to the Maternité the following day weighing 1950 grams. He attained 2710 grams on November 26; then his wet-nurse took influenza, and on December 2 he began to cough. On December 14 he had fallen to 2600 grams, when in less than twenty-four hours he increased 150 grams and died. The night before his death his rectal temperature was 38.3° C.

The quantities of milk he took were relatively small: on December 11 he absorbed 580 grams; 12th, 600; 13th, 580; 14th, 540; and 15th, 480 grams.

I have seen a certain number of such cases; you, yourselves, followed the two I am about to relate.

The first was that of an infant (No. 1703) born on December 24, 1898, with a weight of 3050 grams (Fig. 58). On January 6, 1899, he took erysipelas of the face, which invaded successively the different parts of the scalp, passing by the right, posteriorly, and then to the left. His weight remained almost stationary till January 8; on January 9 he had increased from 2950 to 3050 grams; on January 10, the day of his death, he weighed 3140 grams. In two days he had gained 190 grams.

During these last days he had taken only a very moderate amount of milk; on January 5, 390; 6th, 375; 7th, 405; 8th, 400; and 9th, 415 grams.

Still more recently, on February 13, 1899, there was an infant (No. 196) born with a weight of 2800 grams, in whom convulsions commenced on the first day and did not cease till the fourth. On the fifth day he had diarrhœa with foetid stools, and his weight diminished; on the sixth day he was only 2300 grams, his face had a leaden tint, and his rectal temperature was 39° C. In the next three days he gained 50 grams, and in the twenty-four hours preceding death 250 grams (Fig. 59).

In the last three days, February 22, 23, and 24, he had taken 405, 390, and 380 grams respectively.

At the autopsy a general septic infection arising from a phlebitis in the umbilical blood-vessels was found.

When an abrupt and considerable increase in weight occurs in a sickly infant its imminent death is almost certainly indicated.

Not merely in these exceptional and somewhat deceptive cases, a knowledge of which is essential to avoid mistakes, is the great importance of the balance as a guide to the progress of the child indisputable. It is often said that simple inspection enables a practised eye to appreciate whether an infant is or is not thriving. Don't believe it. Obviously, the general aspect, the firmness of the tissues, the state of the sutures and fontanelles may furnish certain indications, but if you are dealing with several infants at the same time mistakes are easily made. How often at the beginning of my hospital career was I assured that an infant who seemed to me to be suffering was doing well, and on having it weighed before me did I find that it had lost 400-500 grams and was already almost beyond remedial measures. But when at the bed of each mother the chart of the infant's weight is found, a simple glance informs you of its progress, and warns you to seek an explanation, on the slightest departure from the normal.

In your practice, therefore, always have recourse to the balance. Recommend its usage at all times, knowing that nothing can replace it as a means by which to estimate the development of nurslings.

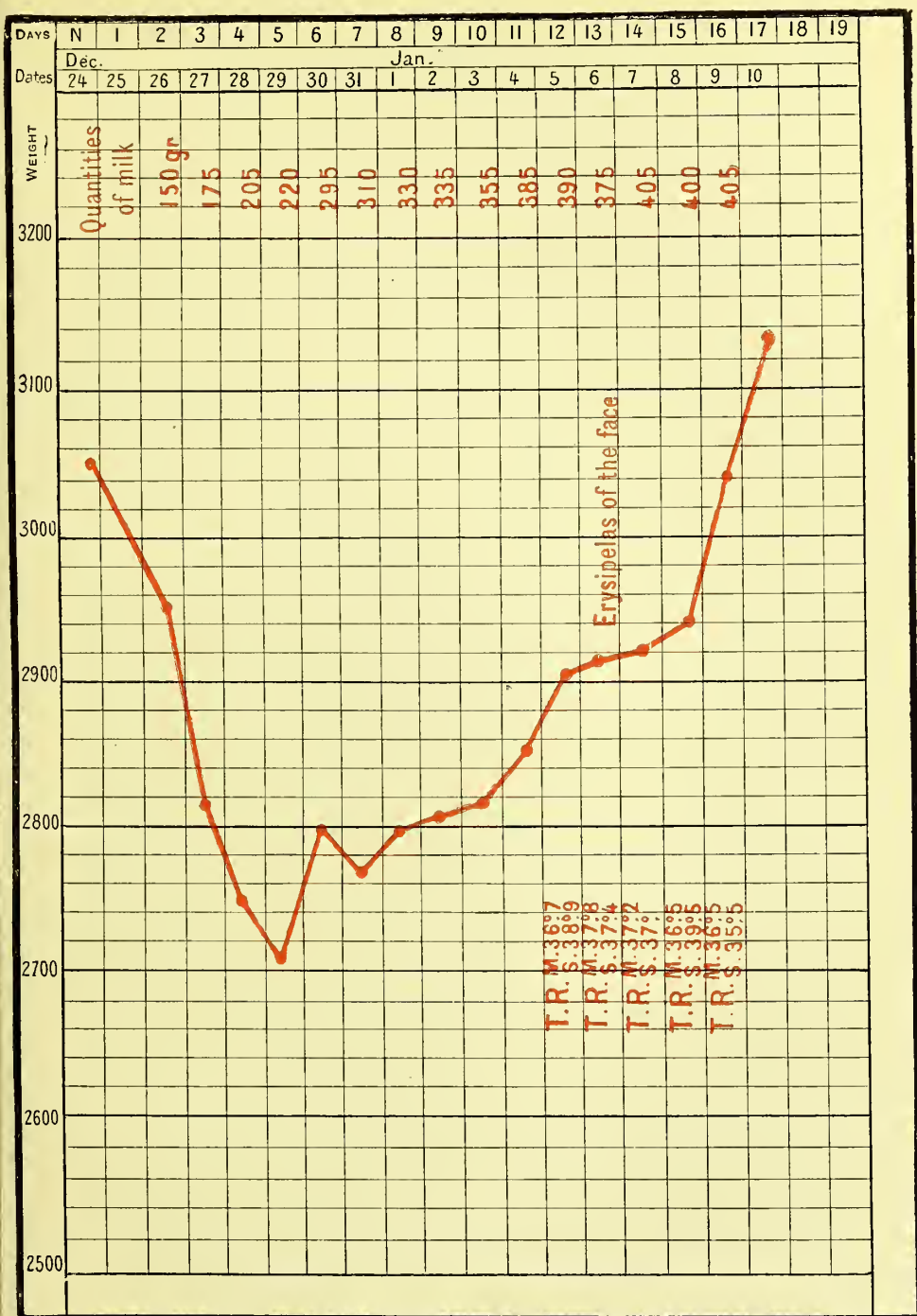


FIG. 58.—Weight curve of an infant who died of erysipelas. Considerable rise in the last two days of life.







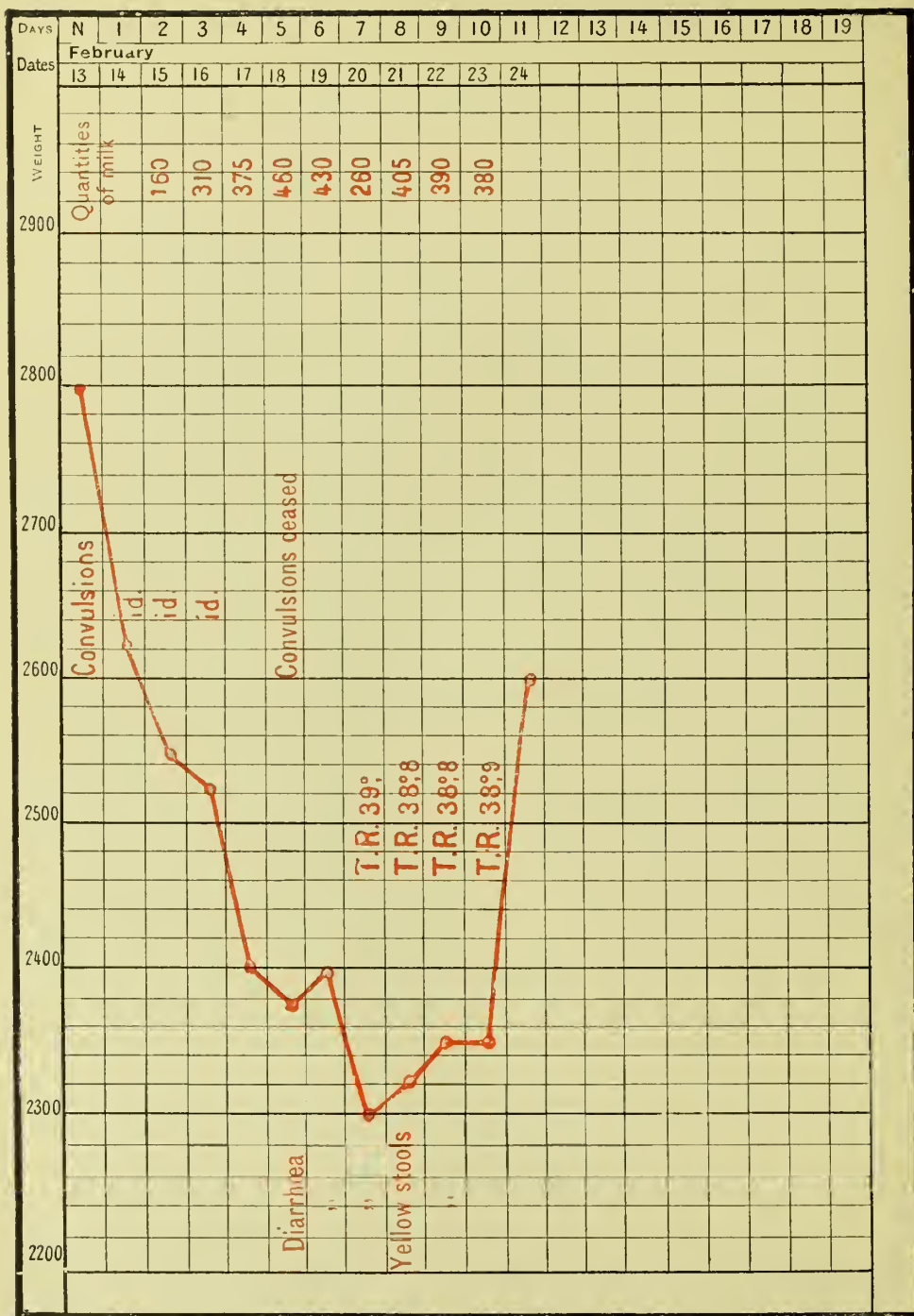


FIG. 59.—Weight curve of a dying infant, showing increase of 250 grams in the last twenty-four hours of life.

## LECTURE VI

SUMMARY :—Mortality in early infancy.

Suckling a maternal duty—Normal growth of an infant—Average curve during the first year.

Effect of emotion, fatigue, and sickness on the lacteal secretion—Reaction on the nursing. Regulation of a nursing mother's mode of living.

Milk overcharged with butter—Examples.

Alcoholism, menstruation, pregnancy in suckling women—Effects on the nursing.

Pathological conditions in nursing mothers—Pulmonary affections—Albuminuria—Cardiac disease.

Suckling in epilepsy, idiocy and cerebral conditions.

GENTLEMEN,

We shall now proceed to the study of the feeding of infants after their departure from hospital.

The newly born should be put to the breast ; an infant ought to be nourished by its mother. This is the general rule, and it has but few exceptions.

The mortality of infants is unfortunately considerable. In 1878 Bergeron wrote: "Without doubt, the first months, and especially the first weeks of life, against which so many causes of disease and death conspire, will always, no matter what we do, yield a higher proportion of deaths than any other period excepting extreme old age. Is it not humiliating, however, for our country and for our generation that, in spite of public and individual hygiene, the mortality among the newly born is such that one can say, without fear of contradiction, that an infant just born has less chance than a man of ninety of living a week, and than an octogenarian of living a year ?"

Infantile mortality has certainly in later years decreased, but much still remains to be done. The beginning is always the most dangerous period of an infant's life. If its feeding then is not directed with the utmost care, grave symptoms soon appear and the infant dies ; sufficient proof of this statement is found in the high death-rate among children entrusted to wet-nurses. We, therefore, strive to continue to guide in the rearing of their little ones the

mothers who have been delivered in this hospital. Our one aim is to secure by advice, by encouragement, and by the use of every means in our power the rearing of the infant at its mother's breast. Unfortunately some women have no milk and others have not sufficient. We do our best to help them by supplementing their efforts, and it is only when it is absolutely impossible to do otherwise that we have recourse to artificial feeding.

Immediately after birth a child loses weight. In about ten days, however, this loss is retrieved, and the average rate of growth is such that if the child weighed 3250 grams at birth, it would reach about 9000 grams at the end of its first year. This growth varies with the age, and is not always accomplished at the same rate. It is rapid at the beginning and becomes less and less as age advances. Here are the figures given by Bouchaud:—

	Birth.	1 Month.	2 Months.	3 Months.	4 Months.	5 Months.	6 Months.	7 Months.	8 Months.	9 Months.	10 Months.	11 Months.	12 Months.
Augmentation .	...	750	700	650	600	550	500	450	400	350	300	250	200
Average weight .	3250	4000	4700	5350	5950	6500	7000	7450	7850	8200	8500	8750	8950

From this it follows that the increase is approximately—

From 25 to 30 grams per day during the first two months.

„ 20 to 25 „ „ 3rd and 4th months.

„ 15 to 20 „ „ 5th „ 6th „

„ 10 to 15 „ „ 7th „ 8th „

„ 8 to 10 „ „ remainder of the first year.

Notice, however, that during the last twenty days of the first month the infant augments more than 25 to 30 grams per day; for if it weighs 3250 grams at birth, and does not again reach this figure till the tenth day, the 750 grams are thus gained in twenty days, so the actual growth is at the rate of 37.5 grams per day.

It must not be forgotten that these are only average figures. It is generally necessary to take an average of several days, as variations, more or less considerable, occur from day to day according as the infant's bowels move freely, or not, or as its daily weighing takes place after a large or small meal.

At the end of one year the infant who weighed 3250 grams at birth will reach about 9000 grams.

Name ..... Christian Names .....  
Date of Birth..... Weight at Birth.....  
Sex..... Mode of Feeding.....

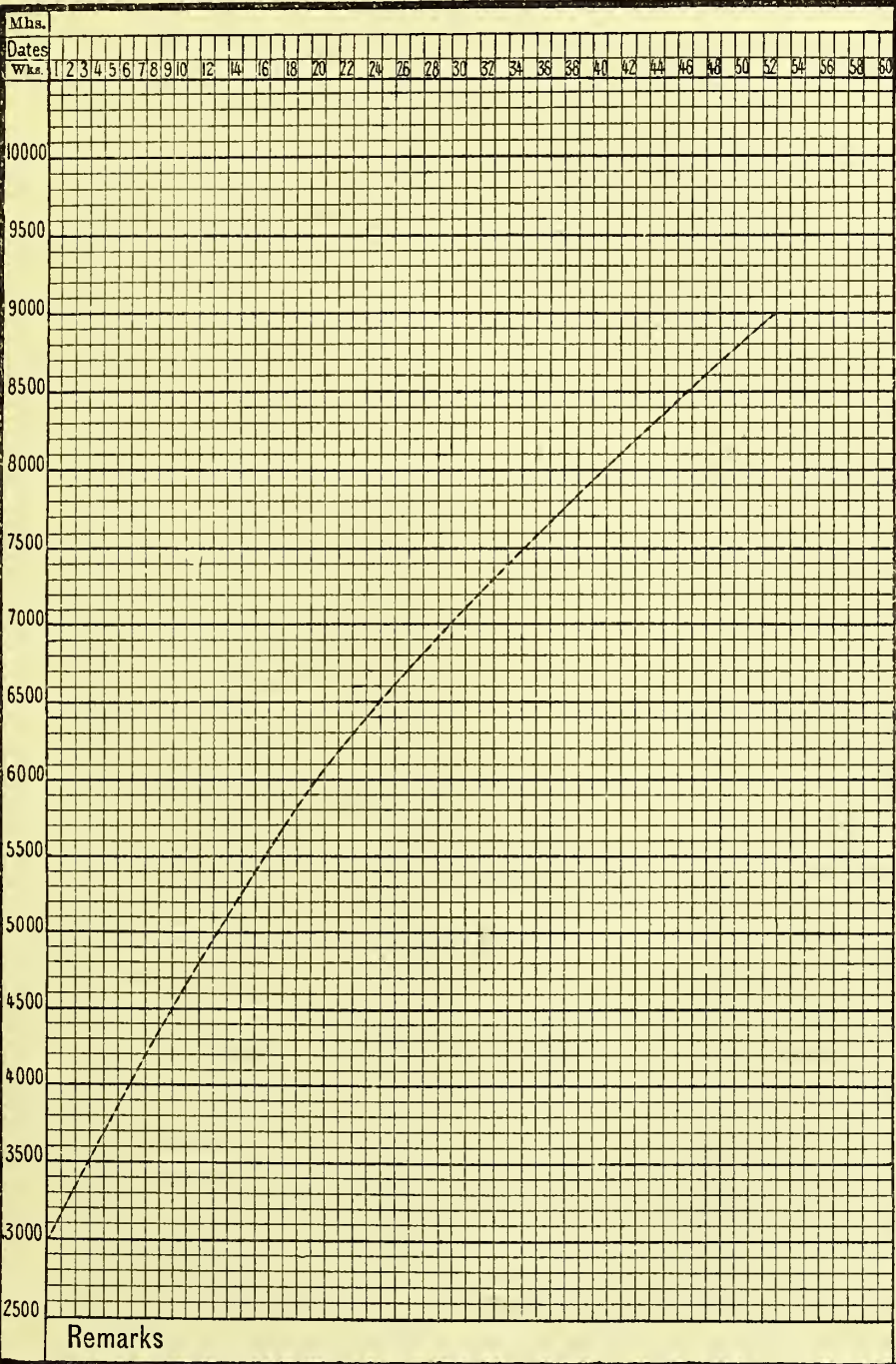


FIG. 60.—Weight curve of the average healthy infant during its first year.







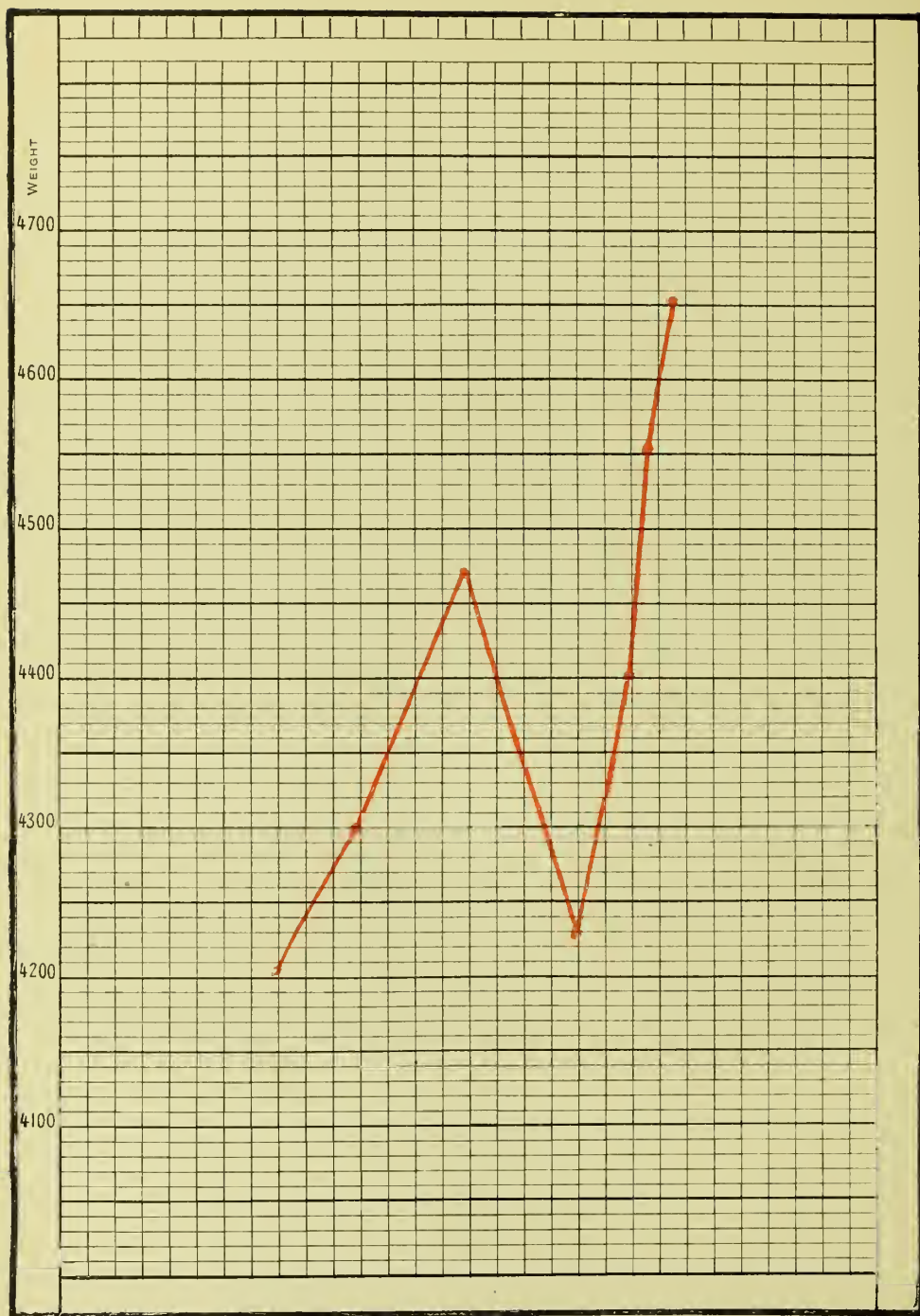


FIG. 6r. —Great emotion in a wet-nurse, causing her nursing to lose weight.

I have represented graphically the progress of the average infant's weight during the first year (Fig. 60). A reproduction of this on a larger scale is used at our Consultations. If a point be placed each week on this chart, in the space corresponding to the weight and age of the infant, the joining of these points will show the curve of its growth, and by comparison, whether it is inferior, equal, or superior to the normal. These charts are of great service both in hospital and in private practice.

I do not wish, gentlemen, to enter into all the details of the breast-feeding of infants, for they can be found in most text-books of midwifery. I shall content myself with calling your attention to some of the more interesting particulars.

In certain cases a mother's milk may be injurious to her infant. This may happen when she has experienced some violent emotion ; when she is in bad health ; and when her milk has an abnormal composition.

Let us examine these various conditions.

There is no doubt that acute mental emotion can affect the lacteal secretion.

The son of a medical friend of mine had an excellent wet-nurse, and was developing regularly. News came, however, of the illness, and, later, of the death of the poor woman's own child. The nursling at once had diarrhœa, and in a few days lost 240 grams. Not many days after the milk regained its good qualities, and the infant became better, and once more began steadily to increase (Fig. 61).

In sensitive women, any analogous occurrence, by bringing about a modification in the composition of their milk, may injuriously affect the health of their nurslings. This is the reason why nervous mothers are so often poor nurses.

But you may object, "Are you sure that such facts are not mere coincidences ? Are you certain you have not overlooked the real cause ?" The reproduction of these phenomena in several infants simultaneously would verify the cause alleged ; thus, if a wet-nurse was giving the breast at the same period to several infants, if these infants were suckled exclusively by her, and if they all presented on the same day modifications in their health and weight, this simultaneous appearance of symptoms would obviously constitute an indisputable proof of the cause under the influence of which they were suffering in common.

I had an opportunity of observing such a demonstration at the Maternité.

The wet-nurse E——, besides feeding her own child, was suckling two nurslings, and all were progressing normally. In the afternoon of September 20, 1895, she had a violent fit of temper, and next morning her infant had diarrhœa, but its actual diminution could not be ascertained, as it was not weighed every day. The weaklings, however, both showed a distinct loss of weight (Fig. 62).

No. 275, infant Jean L——, born on July 27, 1895, was brought to the Maternité with a weight of 1290 grams, and a temperature of 36° C., on August 1; on September 20 he weighed 2160 grams. On that day the wet-nurse had her outbreak, by the next the nursling had lost 30 grams. During the following days its curve again rose regularly, and it left the hospital in good health.

No. 279, infant Louis N——, born on July 6, 1895, was brought to the Maternité on August 3, with a weight of 1880 grams, and a temperature of 36.3° C. He grew steadily. On September 20 he lost 50 grams, and on the 21st, the day after the wet-nurse's tantrum, continued to decrease. On the 22nd he began to progress once more, and in due course left the hospital in perfect health.

Observe the quantities of milk taken daily by each infant from September 15 to 23 :—

Date.	No. 275.	No. 279.	Total.
September 15 . . .	400 grams	480 grams	880 grams.
"    16 . . .	430 "	580 "	1010 "
"    17 . . .	470 "	500 "	970 "
"    18 . . .	450 "	520 "	970 "
"    19 . . .	500 "	530 "	1030 "
"    20 . . .	430 "	510 "	940 "
"    21 . . .	470 "	540 "	1010 "
"    22 . . .	450 "	550 "	900 "
"    23 . . .	480 "	530 "	1010 "

The quantity ingested cannot be blamed, for not less milk was taken from September 20 to 21 than on the preceding days.

But I told you that the infant of the wet-nurse had diarrhœa. On the charts of the two weaklings between September 22, after the morning visit, and September 23, at the same hour, the following were the notes: No. 275, "Stools green, diarrhœa during the night;" No. 279, "Stools liquid, yellow."

There seems to be little doubt that the passion of anger which



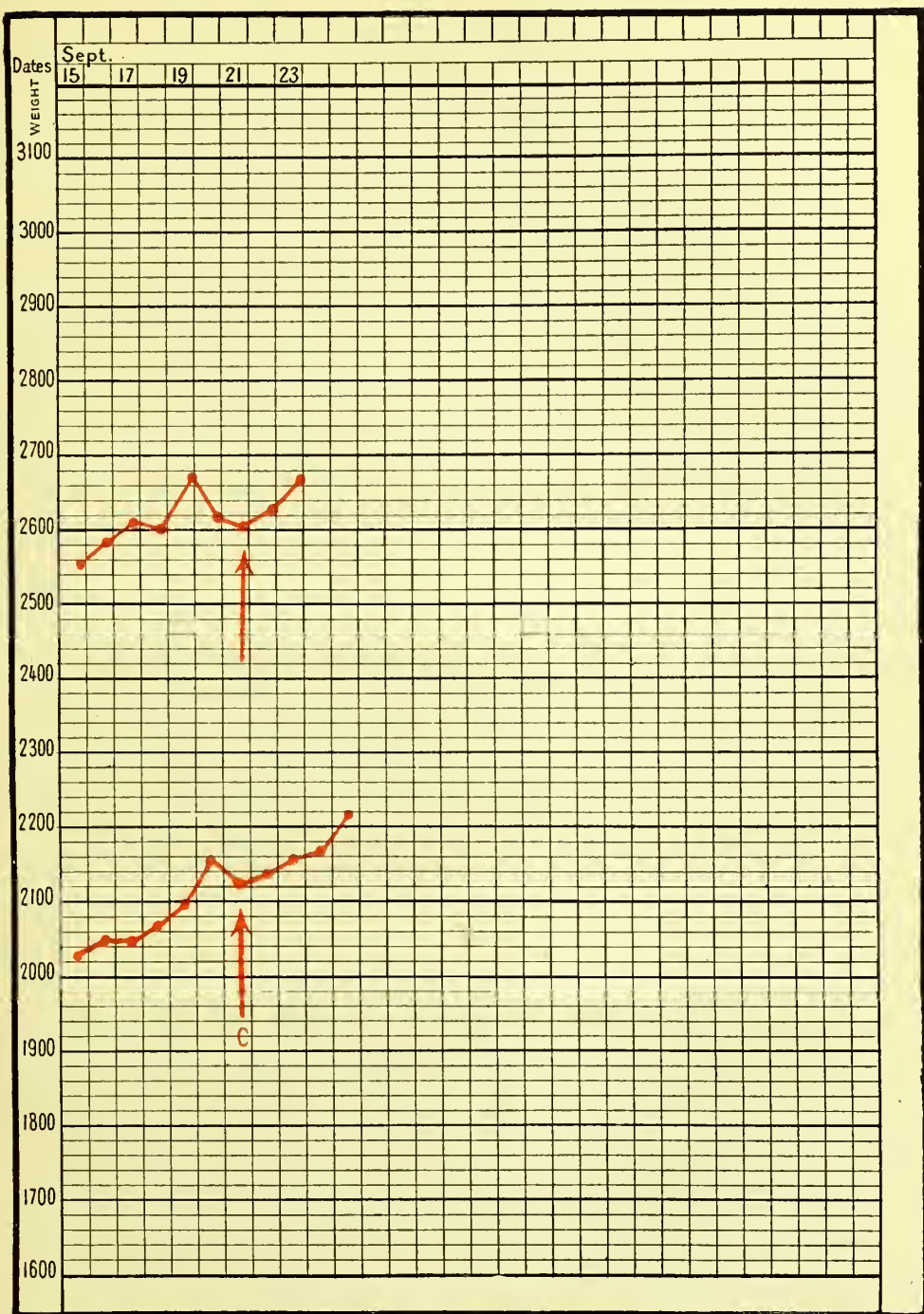


FIG. 62.—Paroxysm of temper in a wet-nurse; effect on the weights of her nurslings.





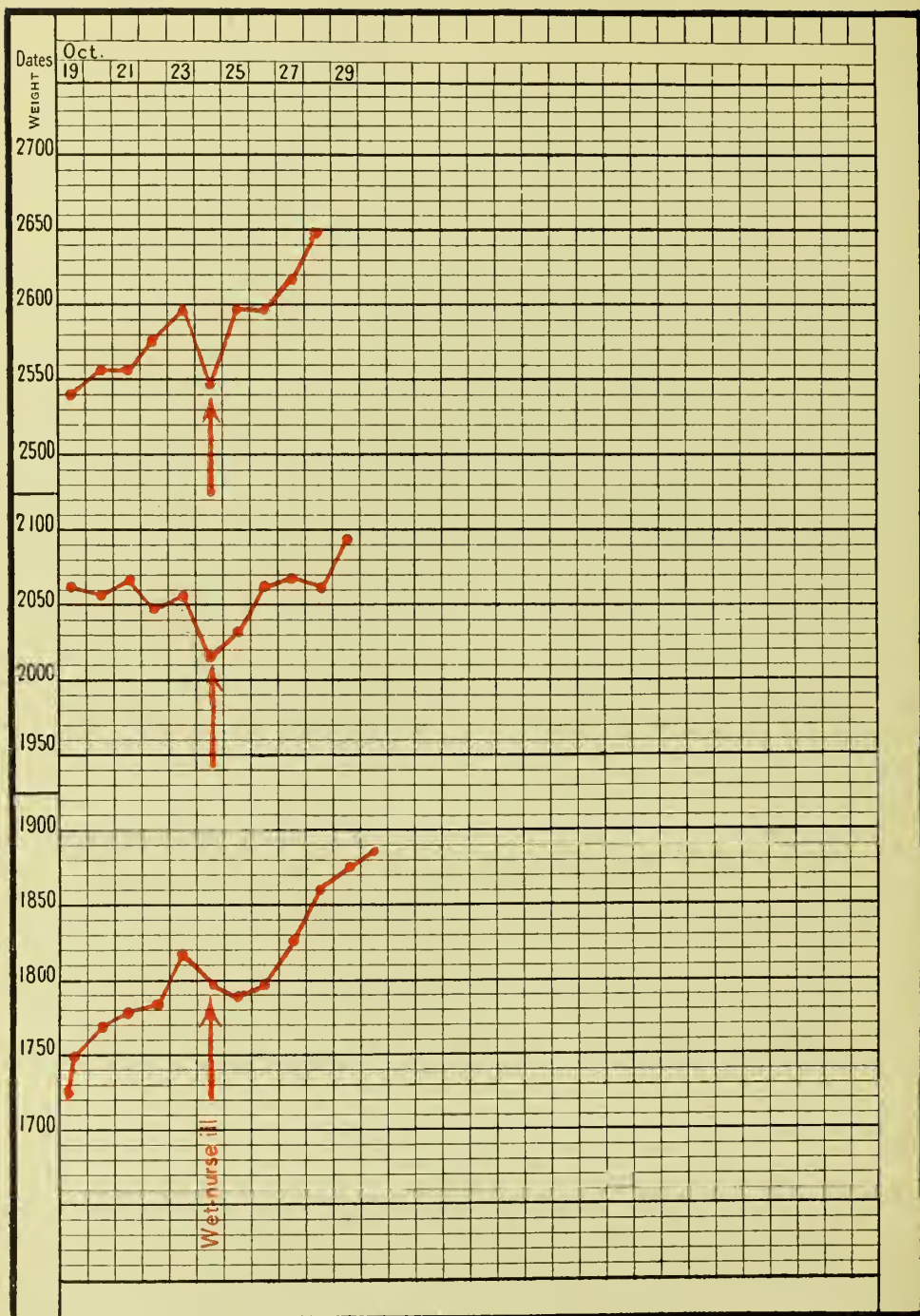


FIG. 63.—Effect on three nurslings of the illness of their wet-nurse.

arose in this wet-nurse so modified her milk as to render it injurious to her three nurslings.

Great fatigue has a similar effect. You may remember that my first knowledge of an attack of influenzal bronchitis among the offspring of the wet-nurses was due to my inquiring why most of the weaklings had lost weight overnight. The reason, I found, was that the wet-nurses were worn out through attending to their own suffering little ones.

Sickness may exercise somewhat the same influence. A wet-nurse, F—— A——, aged 29, delivered on December 15, 1894, had charge of three infants, Nos. 209, 315, and 343, on October 23, 1895. On October 24 she was unwell all day. By the next morning all three infants had lost weight (Fig. 63).

No. 209, Baby Az——, born on June 14, 1895, had steadily increased, and on October 23 weighed 2600 grams. On the 24th he weighed only 2550 grams; he had lost 50 grams in twenty-four hours. Next day his curve again began to rise regularly, and he was discharged in perfect health weighing 2700 grams.

No. 315, the weakling Pierre R——, born on August 29, 1895, weighed on October 23, 2060 grams. On October 24 he weighed no more than 2020 grams, having lost 40 grams in twenty-four hours. On the next day he began to increase again, and later, with a weight of 2820 grams, left hospital in good health.

No. 343, Pierre T——, born on September 22, 1895, had been progressing steadily, and on October 23 weighed 1820 grams. On October 24 his weight fell to 1800 grams, and on the 25th it was only 1790. Then he recommenced to augment normally. On January 1, 1896, he had attained 2135 grams, when he succumbed to an epidemic of bronchitis.

Tabulating the quantities of milk taken by each of these weaklings, we find:—

Date.	No. 343.	No. 209.	No. 315.	Total.
October 19 . . . .	420	630	460	1510
"    20 . . . .	470	660	490	1520
"    21 . . . .	440	660	530	1630
"    22 . . . .	450	630	500	1580
"    23 . . . .	480	700	460	1640
"    24 . . . .	430	600	480	1510
"    25 . . . .	420	590	460	1470
"    26 . . . .	430	590	490	1510
"    27 . . . .	450	680	480	1610
"    28 . . . .	530	600	490	1620



There seems to have been a slight diminution in the amount furnished by the wet-nurse from October 23 to 24. Her indisposition appears to have affected not only the quality but also the quantity of her milk.

If the chemical composition of the mother's milk differs markedly from the normal, the health of the nursing may suffer. In speaking of weaklings I pointed out that if they received the last of the breast contents, a milk rich in butter, their stools sometimes became liquid and only partially digested, and analysis showed that the fæces were loaded with fat. Among full-term infants similar cases occur.

In November 1898, for example, we analysed, in this Clinique, the milk of a wet-nurse, Let——, because the infants entrusted to her had digestive troubles: it contained 61.21 grams of butter per litre.

An infant born on January 22, 1899, in the Rue Magdebourg had copious, badly-digested motions, and sometimes diarrhœa. The wet-nurse's milk at the beginning, middle, and end of a feed was collected and analysed on February 13. Each litre contained 165 grams of solids, of which 80.4 grams were butter. By changing her régime I endeavoured to influence the composition of her milk, but on February 24 it was found still to contain nearly 50 grams of butter. The child's condition did not improve, so I was forced to get him another wet-nurse; a few hours after her advent he ceased to cry and slept peacefully, and two days later his stools became normal.

Some time afterwards the chief of my laboratory, M. Michel, had occasion to examine the milk of a wet-nurse in the service of Madame D——, Rue Taitbout, because the nursing had diarrhœa. This milk contained 66.40 grams of butter per litre. On inquiry I learned that this was the identical wet-nurse whose milk I had previously analysed when she was employed in Rue Magdebourg.<sup>1</sup>

On the other hand, infants sometimes ingest milk containing an insufficient amount of nutriment. That which first flows from an over-distended breast is of this nature. Infants drink great quantities of it; they pass plenty of urine but scarcely increase in weight.

Again, a milk may be too rich in sugar, and here the hygiene

<sup>1</sup> P. Budin and Ch. Michel, "Sur l'utilisation des graisses dans l'organisme du nourrisson." *Bulletin de la Société d'Obstétrique de Paris*, 1899, pp. 191-201.

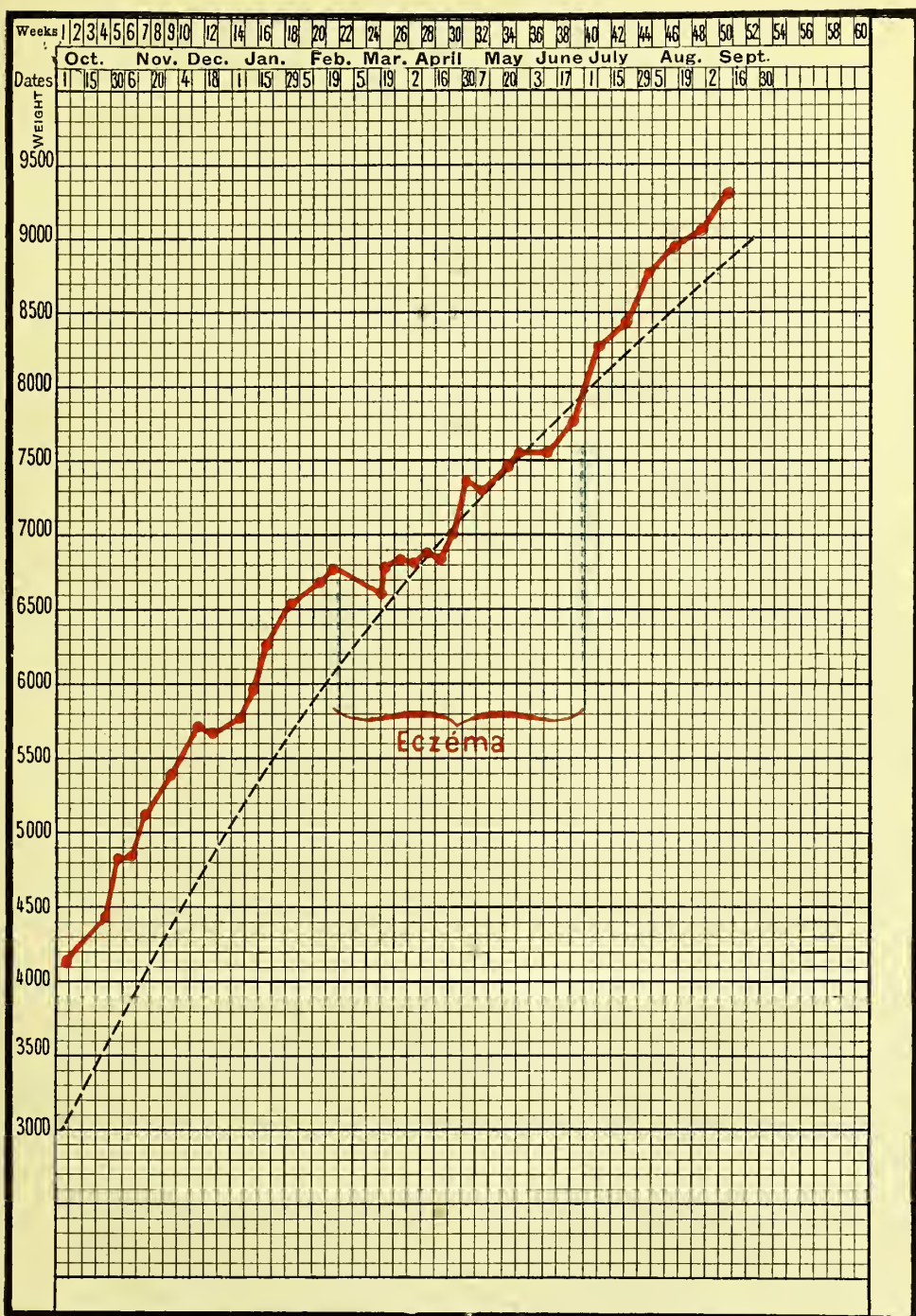


FIG. 64.—Eczema affecting an infant breast-fed by its mother. Cured by regulating the mother's mode of living.





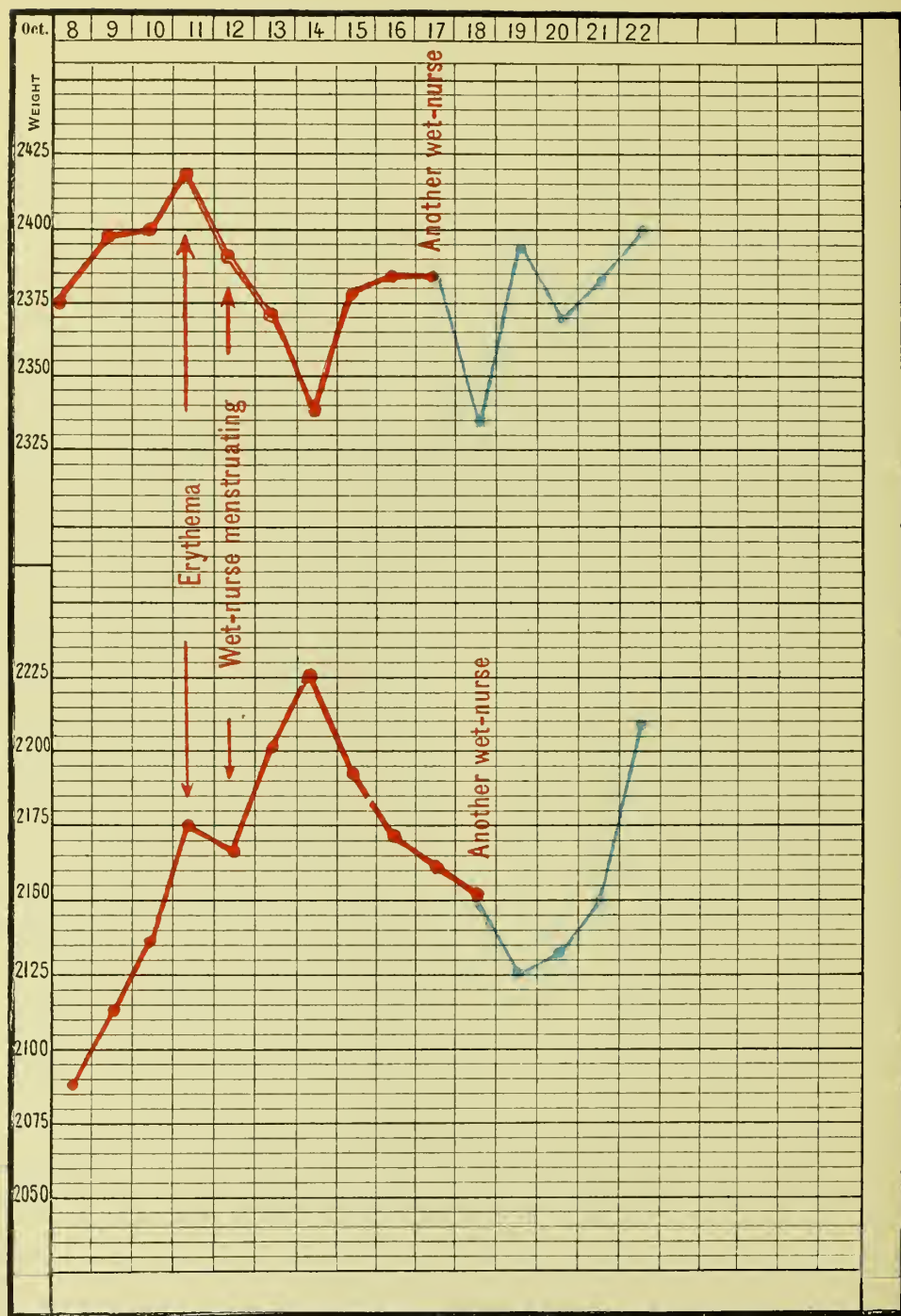


FIG. 65.—The effect on two nurslings of the milk of a menstruating wet-nurse.



of the wet-nurse seems to be a powerful factor. There have been two women attending my Consultations whose children, fed exclusively at the breast, suffered from eczema. One of them, named Sa——, was delivered at the Maternité on October 1, 1897; she left on October 12, when her infant weighed 4375 grams. He continued to increase, and his curve became greatly superior to the normal (Fig. 64). The eczema first appeared on February 12. The mother was a big, stout woman; she ate meat twice every day, drank excessive quantities of wine, and took no exercise. Hitherto, she had been impervious to advice, but now, alarmed by the result of her folly, she modified her habits; meat was eaten but once a day, wine was replaced by milk and mineral waters, and a daily promenade of an hour and a half to two hours was obediently undertaken. As a result, the cure of the eczema was soon accomplished. The infant had continued to increase in weight, but at a reduced rate. Its curve, which previously was beyond the normal, now approximated to it, but, when the eczema was cured, it rose again to surpass the average.

I could cite other examples of the same kind from my private practice. When mothers will lead well-regulated lives as regards food and exercise, and infants cease to be overfed, eczema will be eliminated from the afflictions of nurslings.

Infants suckled by wet-nurses addicted to alcohol are sometimes subject to alarming seizures. Charpentier, Vallin, and others have published interesting cases; here is one to which I was recently called. A foreign lady on a visit to Paris was, on the alleged advice of her medical attendant, indulging in large quantities of quinine wine, which, in order further to fortify herself, she supplemented by bordeaux, champagne, liqueurs, beer, &c. She was suckling her baby, then five weeks old. Since birth it had increased on an average by 30 grams per day, till it weighed nearly 6000 grams. During the night it had taken a convulsion; in the morning a second followed, and I was hastily summoned. I learned that for several days it had been restless and sleepless. As the child, on examination, seemed free from disease, I suspected the symptoms were due to the mother's peculiar régime. But all doubts disappeared, when a still more violent fit followed the infant's being again put to the breast. This attack lasted an hour, and was characterised by periods of convulsive movement supervening on a more or less constant state of rigidity. There were fifteen subsequent seizures, which I controlled with chloro-

form. The maternal feeding was suppressed, a wet-nurse was obtained, and the little one was quickly cured. In three days it had lost 200 grams, which, however, it quickly regained, and soon it began to enjoy the proverbial calm sleep of infancy for the first time in its life.

It is a general idea that once her menses reappear a woman becomes a poor nurse. At the actual menstrual periods her milk may not always be well tolerated. Twenty-three years ago Dr. Ségond and I diagnosed the re-establishment of menstruation in a wet-nurse from periodic disturbances in the health of her charge, and since then I have frequently made similar observations.

The wet-nurse, J——, was suckling two infants at the Maternité in 1895. They were progressing satisfactorily, when in both an erythema of the buttocks appeared, with diminution of weight (Fig. 65). The probability that the wet-nurse was menstruating immediately suggested itself, and inquiry made it an acknowledged fact. These two infants suffered to such an extent that I had to give them to another wet-nurse.

One of them, No. 250, baby M—— L——, born on July 11, 1895, was brought to the Maternité on July 12, with a weight of 1280 grams and a temperature of 36.9° C. On October 11 he weighed 2425 grams; on the 12th, the day the wet-nurse was found to be menstruating, 2390; on the 13th, the date of the first appearance of the erythema, 2370; on the 14th, 2335; and on the 15th, 2380 grams; then the weight remained stationary, and as the erythema persisted, I changed the wet-nurse. Not till October 20 did the erythema completely disappear.

The other, No. 295, infant L—— G——, born on August 10, was admitted to the Maternité on August 11. He steadily increased, so that the 1400 grams he weighed at entry had by October 11 become 2180 grams. We were then surprised to discover an erythema of his buttocks. On October 12, the day the wet-nurse acknowledged she was "unwell," he had fallen to 2170 grams. He increased again for two days, and then began persistently to diminish. The erythema, moreover, did not improve, so it was resolved to change his wet-nurse. The infant then recommenced to increase, and on October 20 the erythema disappeared. In the course of time he attained a weight of 2675 grams, but he succumbed in an epidemic of bronchitis on December 14.

This was a particularly illustrative instance, as it happened in

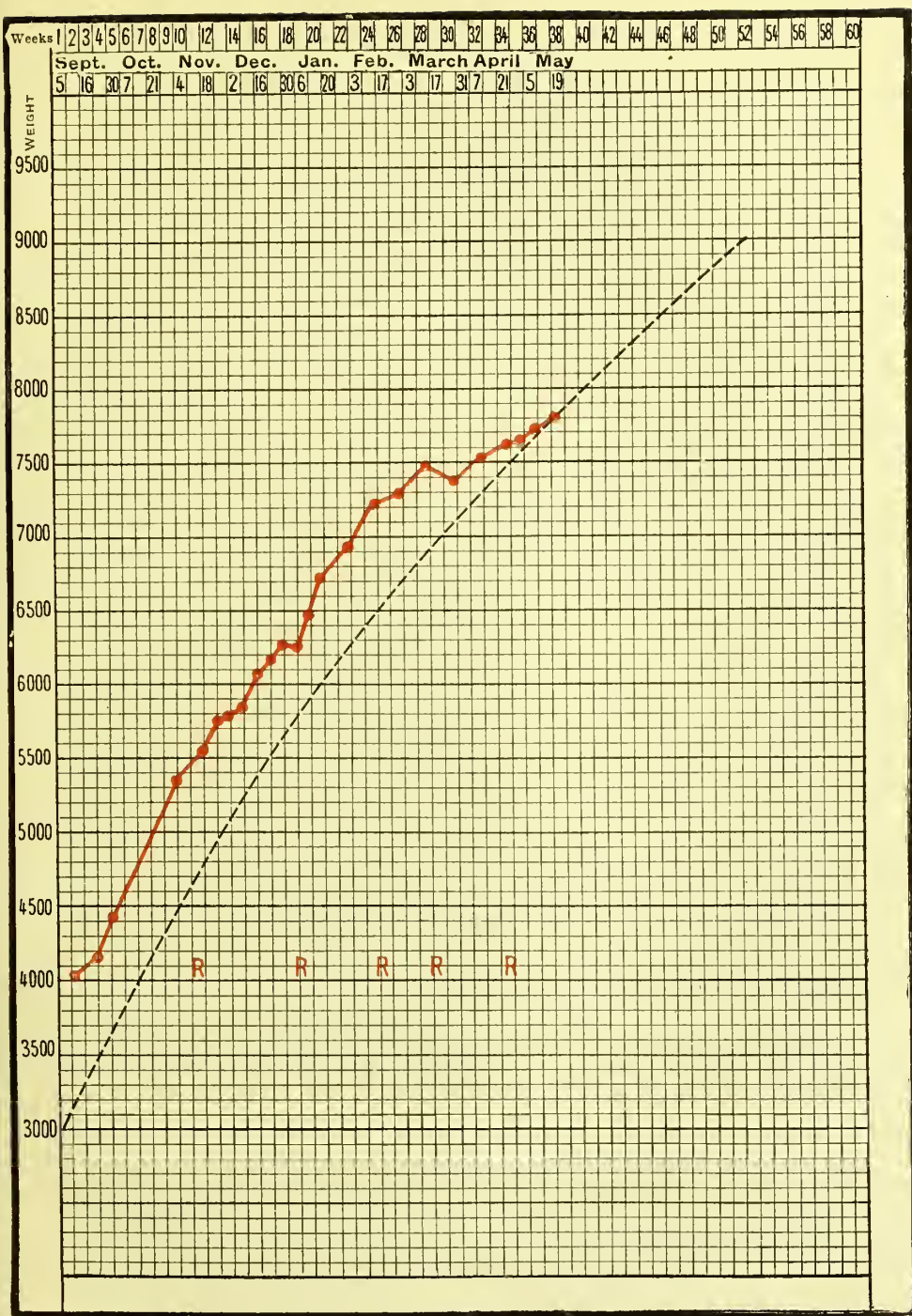


FIG. 66.—Reappearance of the menses in a nursing mother. Deterioration of the infant's curve.







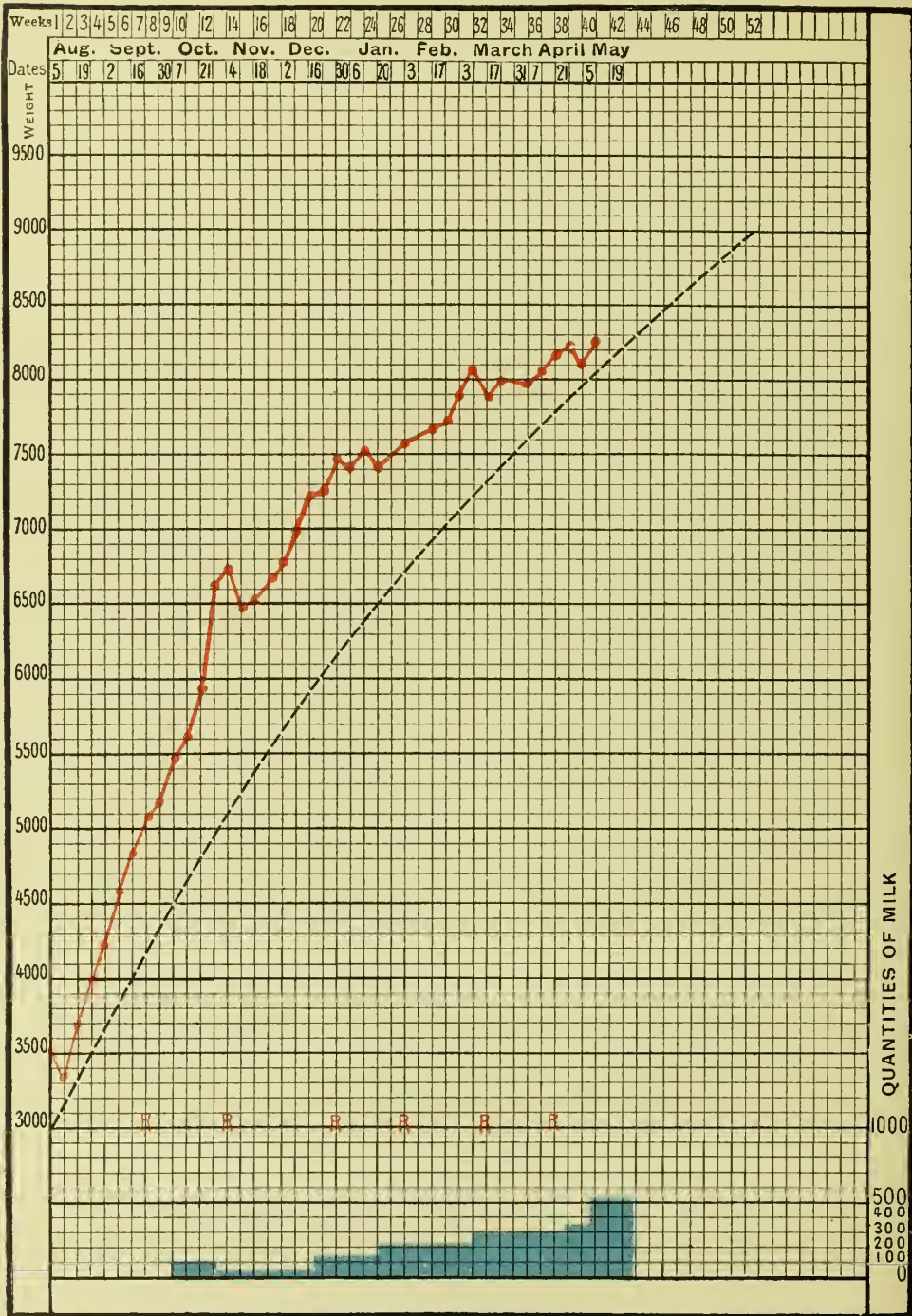


FIG. 67.—Diminution of the mammary secretion owing to reappearance of the menses. Cows' milk in progressively greater quantities had to be added to the infant's diet.

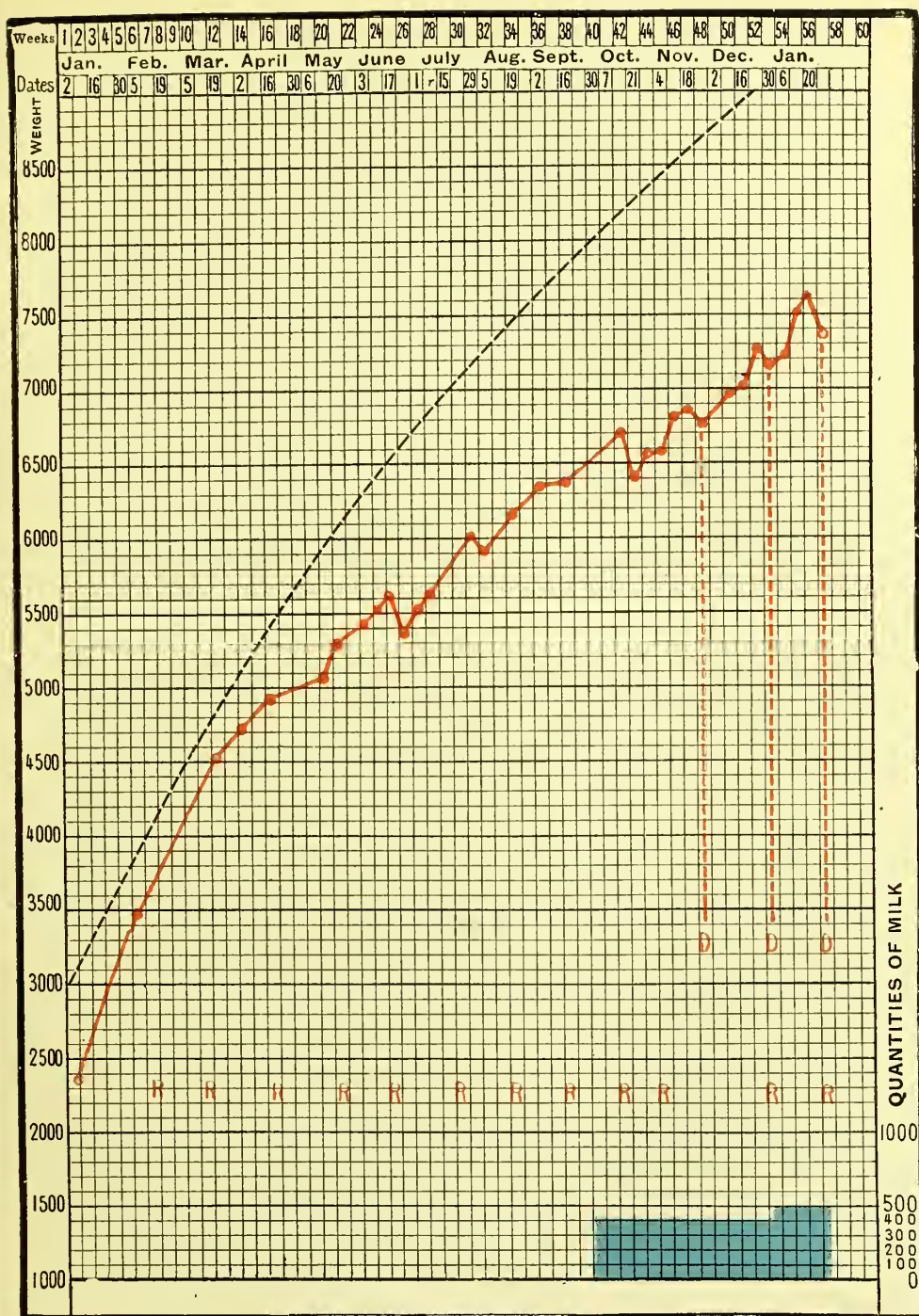


FIG. 68.—Effect of menstruation on a nursing's curve.





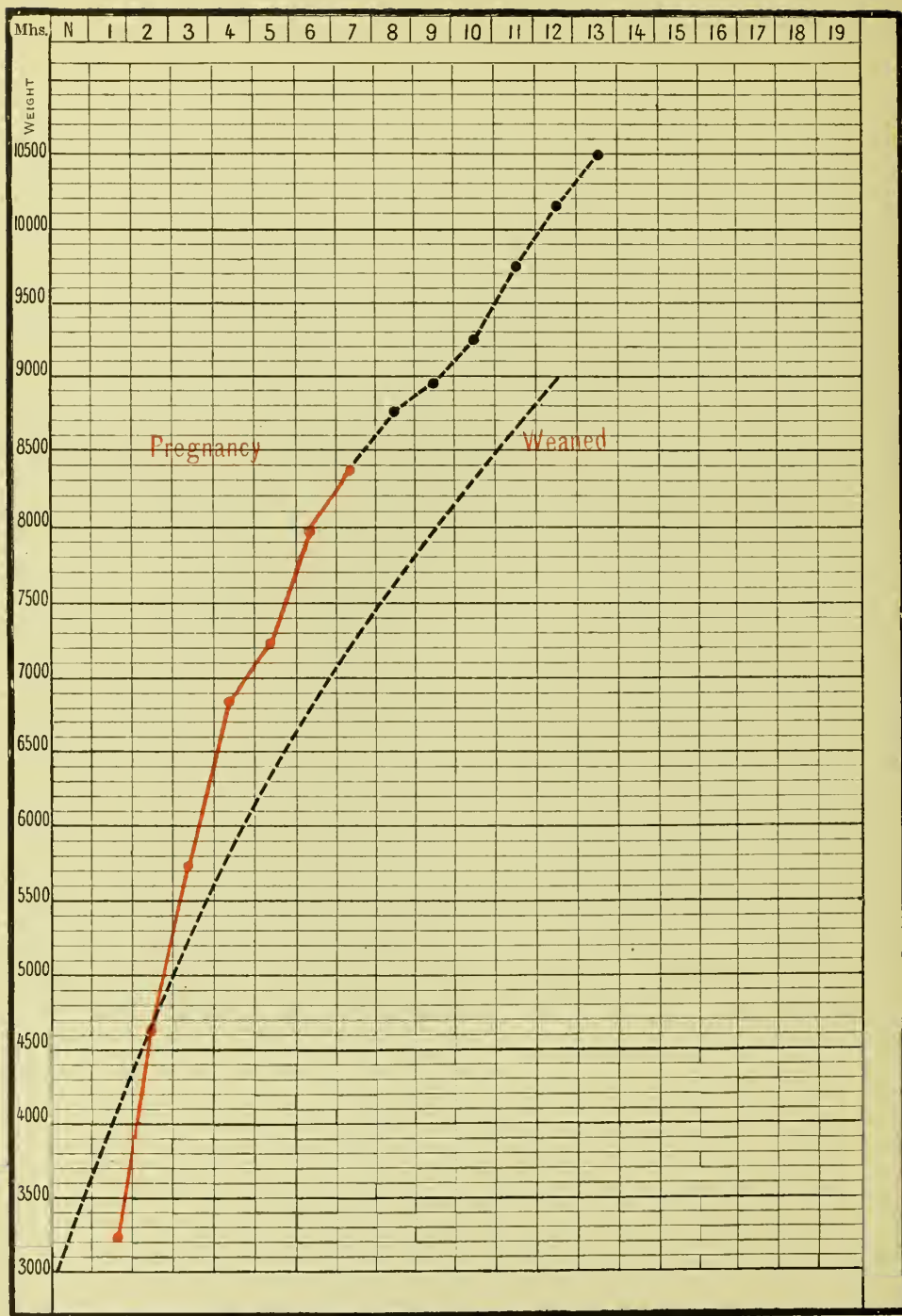


FIG. 69.—Pregnancy in a nursing mother. Note that in spite of the mother's condition the nursing's curve was superior to the normal (Sutiles).



a woman suckling two infants, who both became ill simultaneously when she began to menstruate.

I shall now briefly allude to a series of cases which I have observed at the Consultation, and which show how nurslings may be affected when they are suckled by mothers who menstruate regularly.

A woman named Joul—— was delivered at the Clinique on September 5, 1898, of an infant weighing 4020 grams. He was breast-fed with excellent results, his curve from the beginning being above the average (Fig. 66). The mother menstruated on November 4, December 30, February 10, March 10, and April 21. The infant did not suffer to any extent at the date of the mother's periods excepting on two occasions; on February 10 and March 10 he had diarrhœa with green stools. Otherwise he seemed quite unaffected, but his curve gradually lost its excellence, till it became inferior to the normal which, at first, it had so far surpassed.

A patient called Calm—— was delivered here on August 5, 1898. The infant was fed by his mother, and his curve was far above the average. The woman menstruated on September 30, November 11, January 10, and March 24. At each of these periods the infant lost weight; on March 24 his motions became frequent, liquid, and green, without any ascertainable cause other than the mother's state; and the general aspect of his curve gradually deteriorated, approximating more and more to the normal. Further, the mammary secretion became rapidly insufficient, so that from September 30, it was necessary to give the infant 160 grams of sterilised cows' milk per day. As the maternal supply continued to diminish, this allowance had to be increased, till on January 13 it reached 240 grams (Fig. 67).

A patient named Go—— was delivered in our wards on January 2, 1898, of a weakling who weighed 2350 grams. He was breast-fed, and for ten weeks all went well. Her menses reappeared on February 12, and returned on March 12, April 16, May 20, June 17, &c. The infant, as the curve shows (Fig. 68), diminished in weight during only one of those periods. Nevertheless, the mother was far from being a good nurse.

I do not wish from these cases to conclude that menstruating women are always bad nurses, and that it is preferable that they should not suckle. This would not be at all justifiable. If in some infants diarrhœa supervenes, and in others the weight diminishes, in others again there is no appreciable change in health.

Exclusive maternal feeding may thus sometimes be continued with complete success, but more frequently it is necessary to supplement the insufficiency of the mother's secretion with cows' milk.

It is well, however, to know these details, in order to be able to distinguish the true cause of troubles temporarily arising in an infant's health. We shall not only be spared undue anxiety, but also be enabled, when necessary, to apply the appropriate remedy.

It is the current belief throughout France that the milk of a pregnant woman is harmful, and therefore, when a nursing mother thinks she has conceived, she straightway ceases to suckle. Many facts made me suspect that this opinion was without foundation, so I requested one of my pupils, Dr. Poirier, to accumulate the necessary data to enable us to arrive at a definite conclusion.

He collected fifty-one observations, and found that in 72 per cent. of cases nursing by a pregnant woman occasioned no disturbance to the health of the infant.

In 8 per cent. no rigorous conclusion could legitimately be drawn from the observations.

In 20 per cent. the infants manifested such symptoms as necessitated immediate weaning.

As Dr. Poirier remarks, "In order definitely to settle the question we require to know in what proportion of cases non-pregnant nursing mothers are able to complete the suckling of their offspring."

My personal experience enables me to confirm the opinions of Dr. Poirier.

In one case a nursing mother came to consult me at the Charité. She had felt a sensation which she described as resembling "quickenings," but as the baby at her breast was in excellent health, she could not believe herself pregnant. On examination I found her advanced about four and a half months. The chemical composition of her milk was found to be absolutely normal. As I wished to photograph the infant, and to make another analysis of the milk, she promised to return in a few days; but scarcely had she crossed the threshold of the hospital, when she allowed a neighbour to persuade her that the pregnancy would surely have an injurious effect on her child at the breast. She sought the advice of an herbalist, and he sold her some drugs to dry up her milk. When next I saw the child he was completely weaned, and he looked so thin and ill that I could hardly recognise

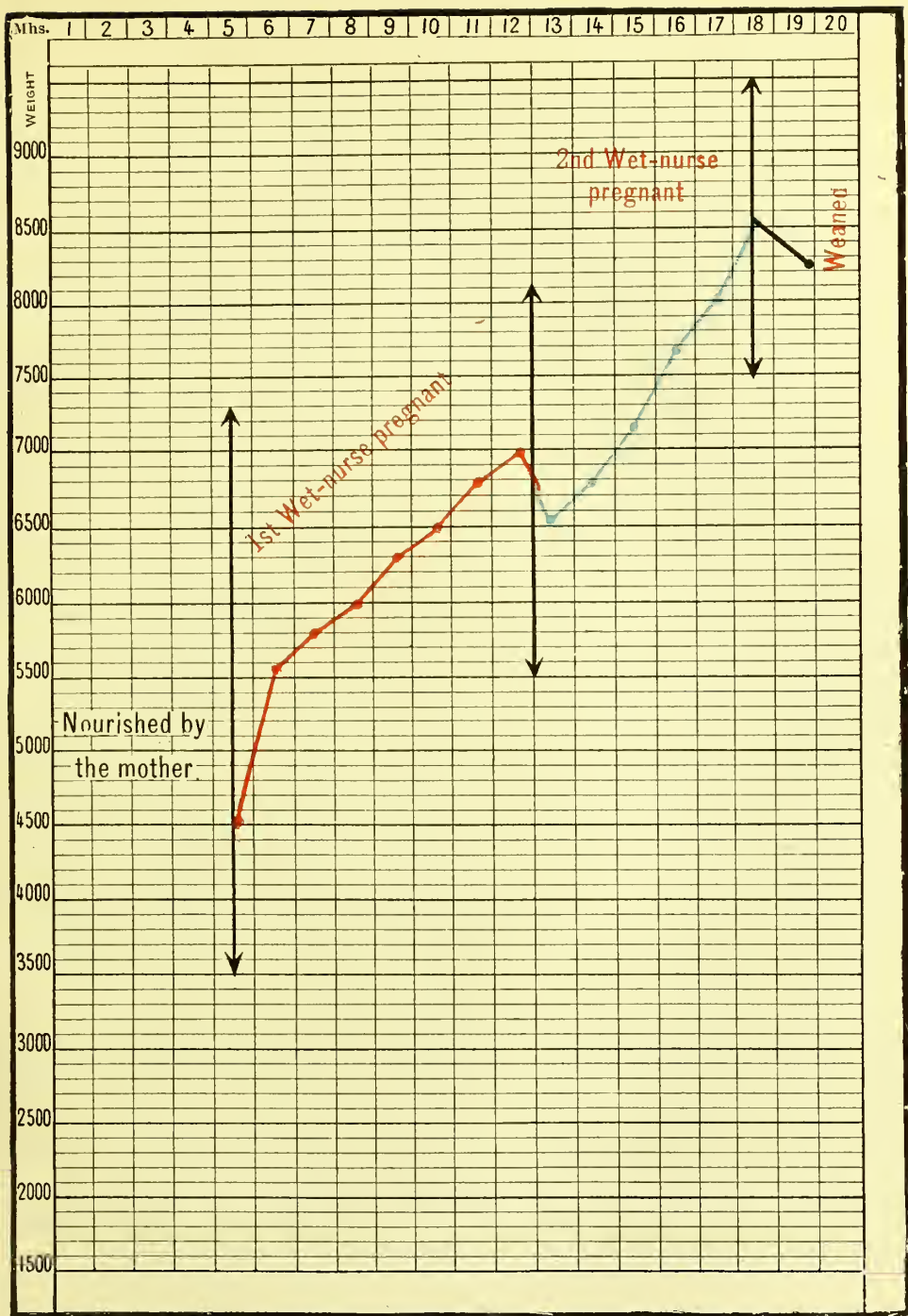


FIG. 70.—Infant first nourished by its mother, then by two wet-nurses in succession, each of whom became pregnant (Sutis).







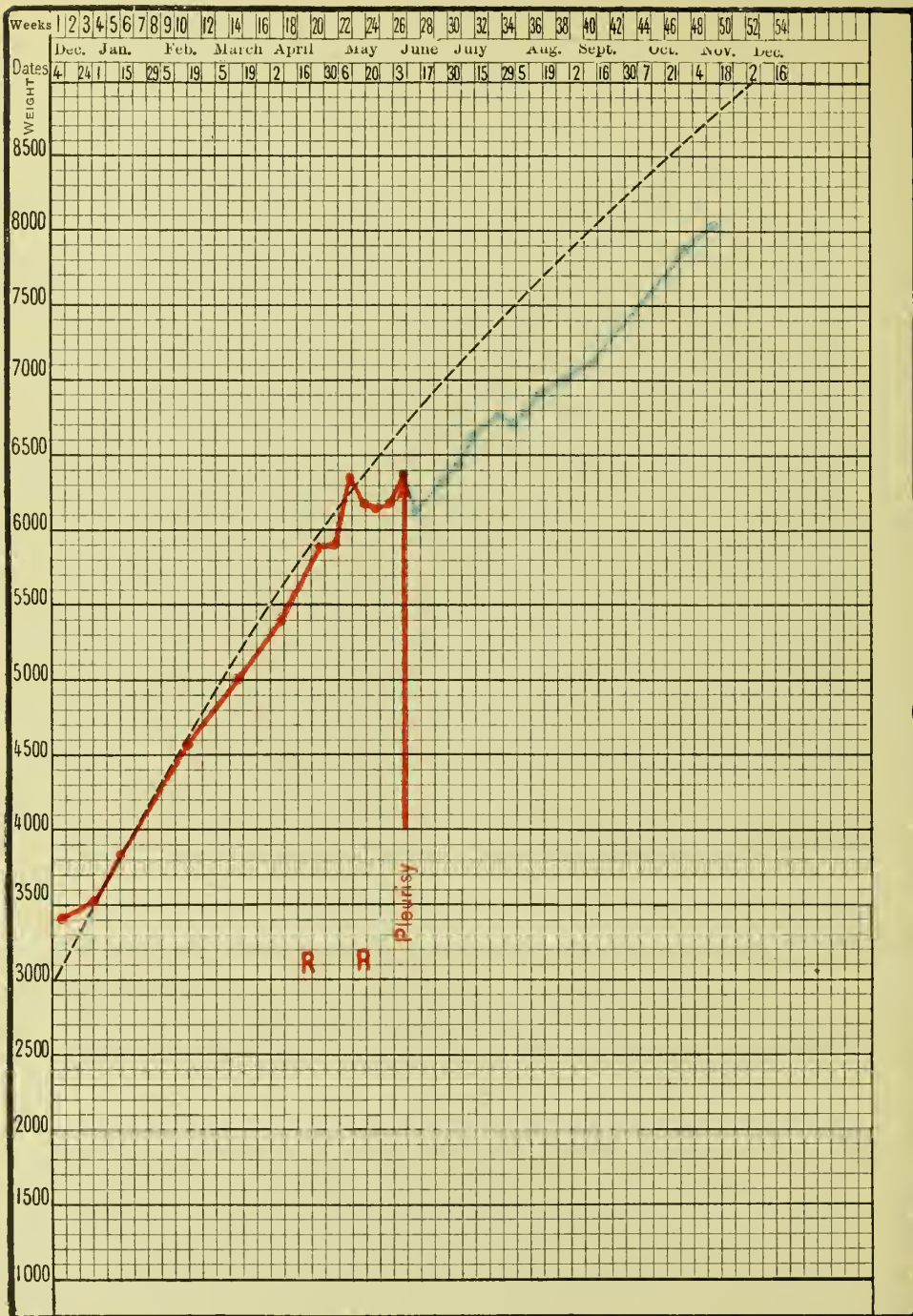


FIG. 71.—Breast-feeding suppressed owing to acute pleurisy attacking the mother. Infant, a girl, fed artificially. At first too little milk was given and she lost weight, but when the amount she required was reached she grew rapidly.

him. So striking was the contrast that I greatly regretted that I had not taken the photograph on his first visit.

In the great majority of cases the appearance of pregnancy in a nursing mother gives rise to no unfavourable symptoms in her infant, but, especially in large towns, there is always a question of the fitness of the mother to bear with impunity the simultaneous strain of nursing and pregnancy.

Sutis,<sup>1</sup> who from the wealth of his experience has collected twenty-six observations of pregnancy during nursing, has arrived at conclusions analogous to those I have just stated. According to him the milk of a pregnant woman may be insufficient in amount, but it is entirely free from any noxious influence on her nursling. He reports, among others, the two following cases:—

In the first (Fig. 69), the mother was cognisant of her pregnant state, but the infant was not weaned till the eighth month. Obviously, it did not suffer from the mother's condition, as its curve excels the average.

In the second (Fig. 70), the mother to begin with tried to rear her infant at the breast, but had not enough milk; she then fed it artificially, but as it did not thrive, it was handed over to a breast wet-nurse, whom it vigorously sucked. The wet-nurse became pregnant, and her milk supply having diminished, the child made almost no progress. It was then given to a second wet-nurse, who also became pregnant; in this case, however, the milk continued to flow freely, and the infant steadily prospered.

I think we are justified in concluding that the popular belief that pregnant women are dangerous wet-nurses has no foundation in fact.

Pathological conditions in the mother are generally thought to contra-indicate nursing. There is no doubt that some diseases, such as phthisis and acute pulmonary affections, do necessitate its suspension, but if artificial feeding be well directed from the beginning, the infant may continue to progress favourably. For example, on December 6, 1897, a woman named Mav—— was delivered of her third daughter; she had reared the others at the breast, and had also faithfully brought them to my Consultation. So well did the infant thrive that its curve was above the average. On May 18, however, it lost 150 grams on the reappearance of the

<sup>1</sup> Sutis, "Contribution à l'étude de l'influence de la grossesse chez les nourrices." *L'Obstetrique*, 1898, pp. 60-67.

mother's menses. On June 3 I was told, when the infant was brought to me, that, as the mother was attacked with acute pleurisy, her doctor had forbidden nursing. The child was ordered eight bottles of pure sterilised milk per day, each of which held 75 grams, or 600 grams in all. On June 10 I found that the infant was in no way the worse of being weaned, and that her stools were quite normal. As she had lost, however, 250 grams, it was evident I had not given quite enough. Having had her ration increased to nine bottles of 75 grams each, or 675 grams per day, by June 14 she had gained 170 grams. The mother happily recovered, and the infant, although weaned, continued to thrive.

But beyond pulmonary affections, there are certain other pathological conditions in which the exact course to be pursued is still a matter of discussion, and, therefore, in need of further investigation. For example, what is the correct attitude in cases of eclampsia or albuminuria, where the albumen persists after delivery? Ought these women to be allowed to suckle? This is a matter of great practical importance.

Dumas and Cassin, from their observations, deduced that all women with albuminuria beyond the third day after delivery ought to cease to nurse.

Gamulin, in 1896, collected 158 observations at the Clinique Baudelocque, from which he formulated the following opinion: "I believe I am justified in concluding that an infant nourished by an albuminuric mother develops and increases in weight in the same proportion as other infants.

"Moreover, albuminuric mothers who nurse their offspring, even although they are restricted to milk diet exclusively, derive those benefits which accrue to every woman who fulfils this physiological function. Nursing does not expose them to any undesirable consequences, either as regards their albuminuria, or as regards their general health.

"It follows, therefore, that every albuminuric mother can and ought to nurse her child. It is only in those exceptional cases in which the albuminuria increases or does not diminish during several weeks that the maternal feeding ought to be suspended. For the rest, if the infant does not thrive at the mother's breast, which may happen with these as with healthy women, another nurse may be tried."

With my former assistant, Dr. Chavane, I have studied this

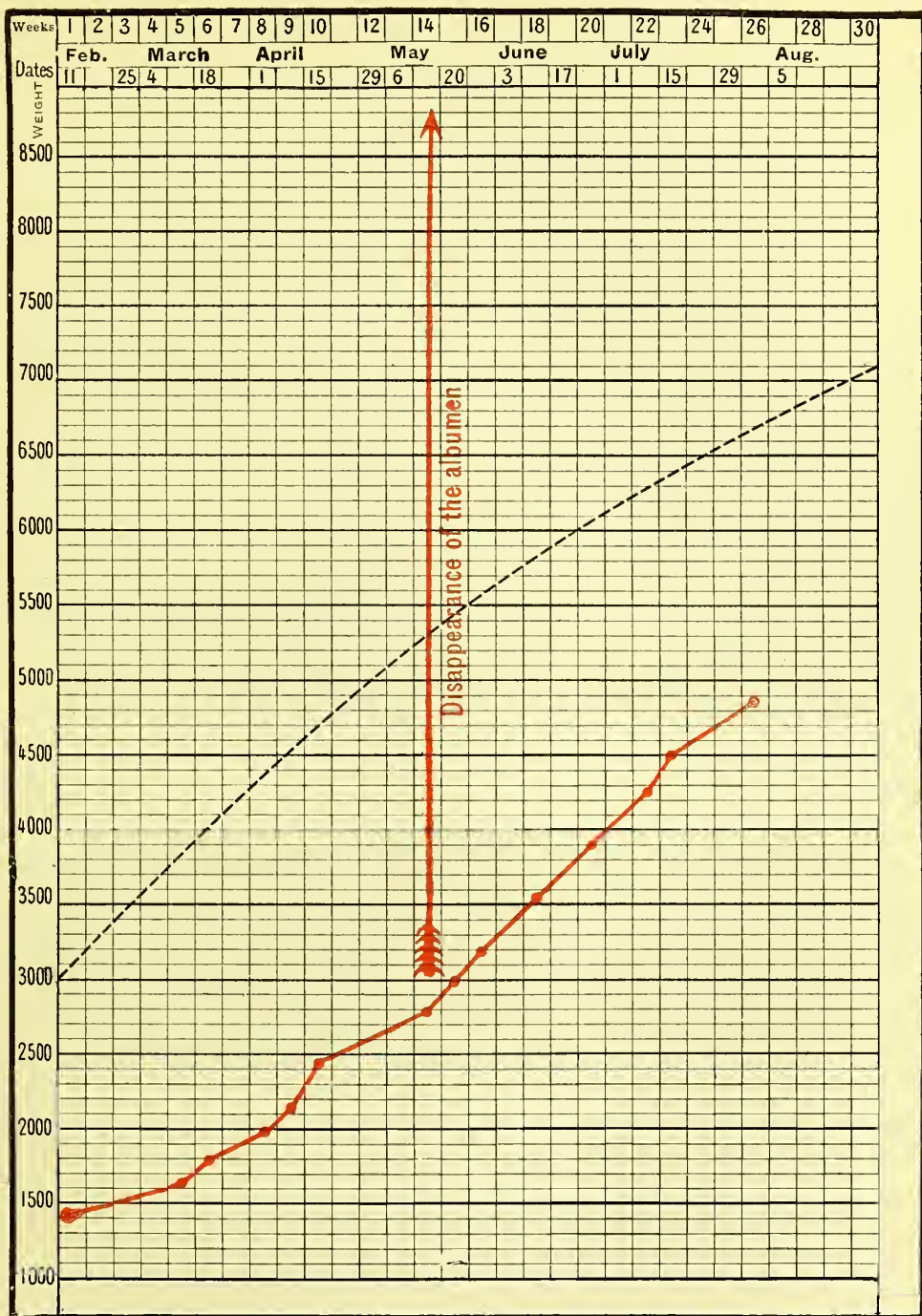


FIG. 72.—Eclampsia and premature labour. Albuminuric mother successfully suckled her child. The red arrow marks the complete disappearance of the albumen.









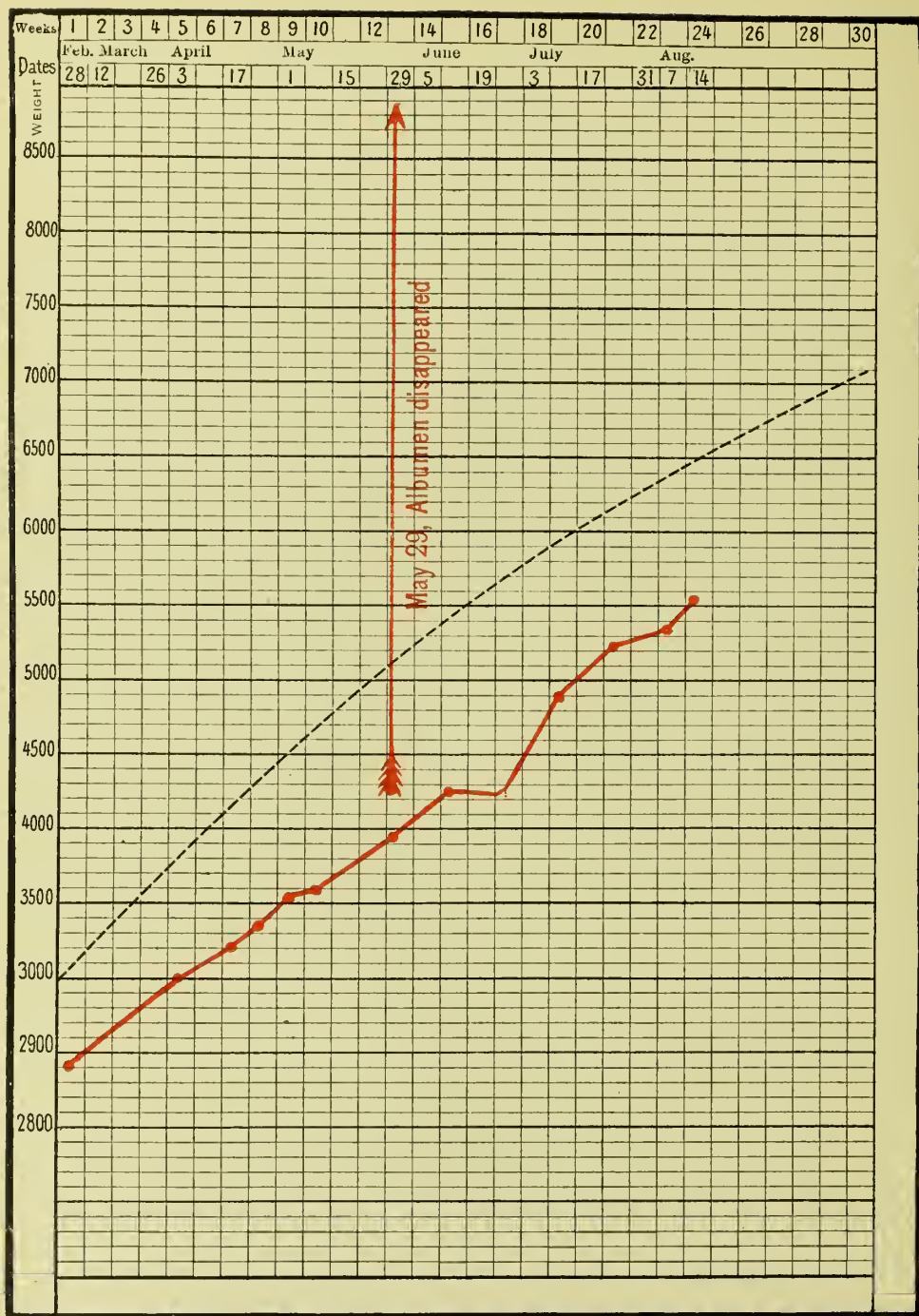


FIG. 73.—Weight curve of an infant suckled by an albuminuric mother.

question at the Charité, the Maternité, and here, at the Clinique Tarnier.<sup>1</sup>

At the Charité there were no wet-nurses, and every woman, including those who had albuminuria, had therefore to nurse her own infant, but yet I never saw any untoward results in either mother or child. From 1895 onwards I successfully continued this practice at the Maternité, and in renal cases I found the albumen usually disappeared at the end of several days.

But what happens in cases of persistent albuminuria? Formerly, we had no information on this point, but, thanks to the Consultation for Nurslings, I have been able to follow several albuminuric mothers throughout their whole nursing period. Here are three of my observations:—

B—— was brought to the Maternité on January 21, 1895, having had eclamptic fits. The pregnancy continued till February 10, when a premature infant, weighing 1430 grams, was born. The albuminuria continued till May 11, but yet the mother suckled her child and proved an excellent nurse. On August 3 the infant reached 4800 grams, and its curve steadily rose parallel to the normal (Fig. 72).

A woman named Dub——, delivered at the Maternité on February 28, 1897, had severe albuminuria and considerable œdema. Her infant weighed 2400 grams, and was nourished exclusively at her breast. Its curve closely follows the normal line (Fig. 73). Not till after three months, on May 29, did the albumen completely disappear. By August 14 the infant reached 5500 grams.

A primipara of thirty, named Dup——, who was delivered of twins on September 7, 1894, had very marked general œdema. The smaller twin, 2050 grams in weight, lived only for a few hours; the other, who weighed 2650 grams, was nursed by the mother. As she had scarcely enough milk, 200, 250, and 350 grams of pure sterilised milk were gradually added to his daily supply. Although the œdema persisted in the mother's face for a month, and the albuminuria lasted till the ninth week, the child flourished splendidly, and soon was beyond the average weight (Fig. 74).

From my own observations, I am of opinion that women who have albuminuria, and even those who have had eclamptic fits, are

<sup>1</sup> P. Budin et Chavane, "De l'allaitement chez les femmes qui ont eu de l'albuminurie de la grossesse." *Bulletin de la Société d'Obstétrique de Paris*, March 16, 1899, pp. 84-95.

quite capable of nourishing their offspring. Often the albumen rapidly disappears, and the nursing follows an uneventful course. Even in a case of exceptional persistence of albuminuria, nursing can still be continued without seeming to impede the definite cure of the mother. When she has not enough milk, her supply should be supplemented just as in ordinary cases. Needless to say, a careful watch must be kept over mother and infant, so that if complications arise the breast-feeding may be at once suspended.

In cardiac disease nursing is clearly contra-indicated. Yet here is a case in which a mother, although suffering from valvular disease, insisted on rearing her child at the breast.

A woman named Gaz——, who had mitral incompetence, gave birth prematurely to twins at the Maternité on October 30, 1896. The one, Jeanne, weighed 1550 grams; the other, Désirée, 2200 grams. I did not allow the mother to nurse. I placed the little ones in the department for weaklings, and, in due course, sent them to the Pouponnière, where they attained 5000 and 5100 grams respectively. They have both grown into very pretty girls, and are a source of much pride to their mother.

Having become pregnant again, she gave birth on February 12, 1899, in our Clinique, to a boy weighing 2350 grams. I intended to entrust him to one of our wet-nurses, but I yielded to her entreaties and allowed her to suckle him herself. When she left hospital, I advised her to feed him on sterilised milk, but, seeing her infant thriving, and fearing the consequences of changing his diet, she persisted in rearing him at the breast. When next I saw the infant he was in splendid health, but the mother was worn out. As it seemed to me that she was running great risks, I urged her to wean him, but she refused to do so until I assured her that the change would do her son no harm.

Should idiots, epileptics, and women with other cerebral affections be permitted to nurse? Especially with epileptics, the infant may be exposed to grave dangers. But what is to be done when the mother is too poor to provide her infant with a substitute? And what will become of the child if it be entrusted to a mercenary who is not properly supervised?

Several years ago I allowed an epileptic, a former patient at the Salpêtrière, to suckle her child. During the nursing period the fits were few, and when she felt their approach she placed her infant in safety. No harm ever befell him, and he made excellent progress.

At present, a woman named Des—— is attending our Con-

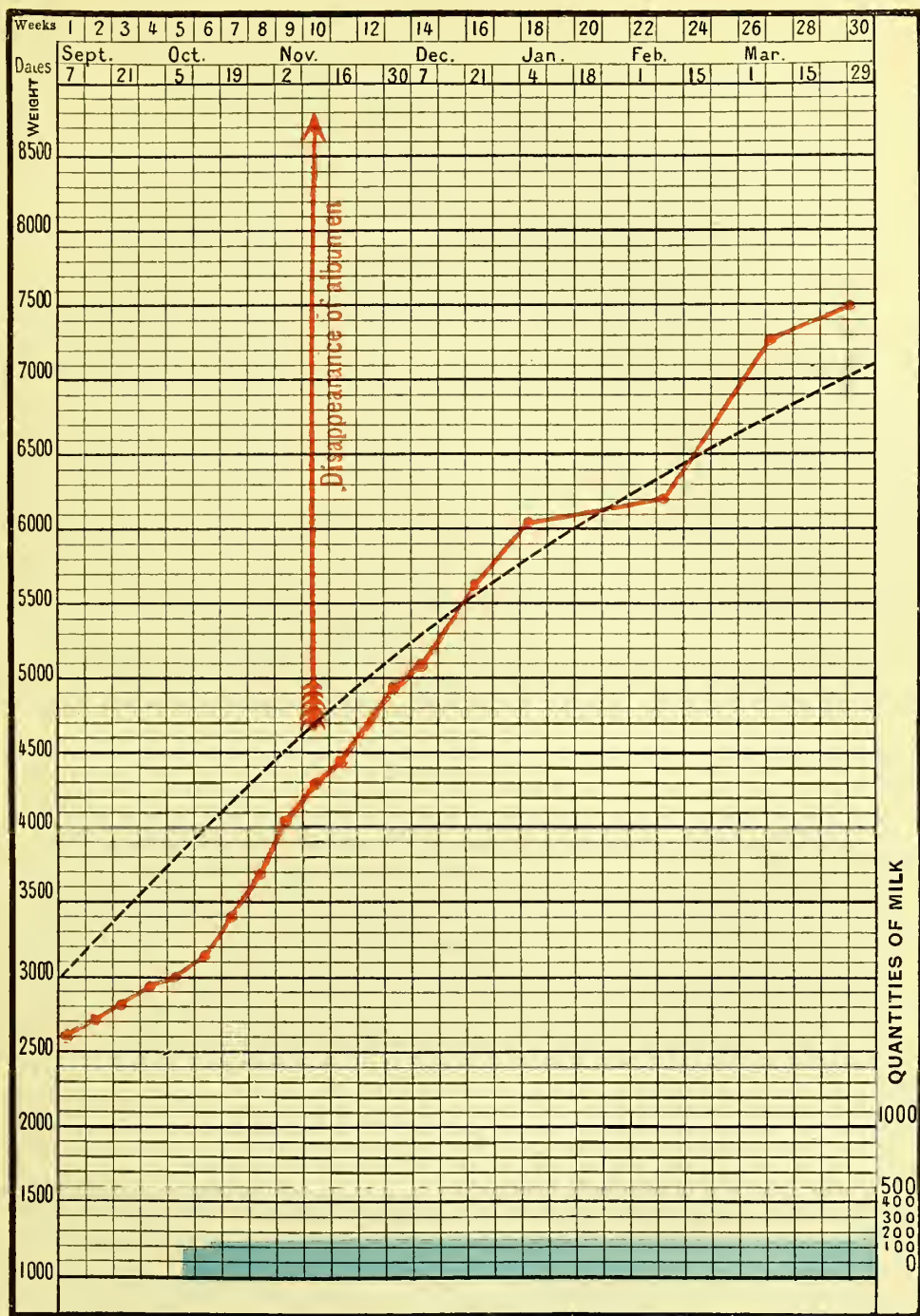


FIG. 74.—Infant suckled by albuminuric mother. As her supply was inadequate, mixed feeding had to be practised.







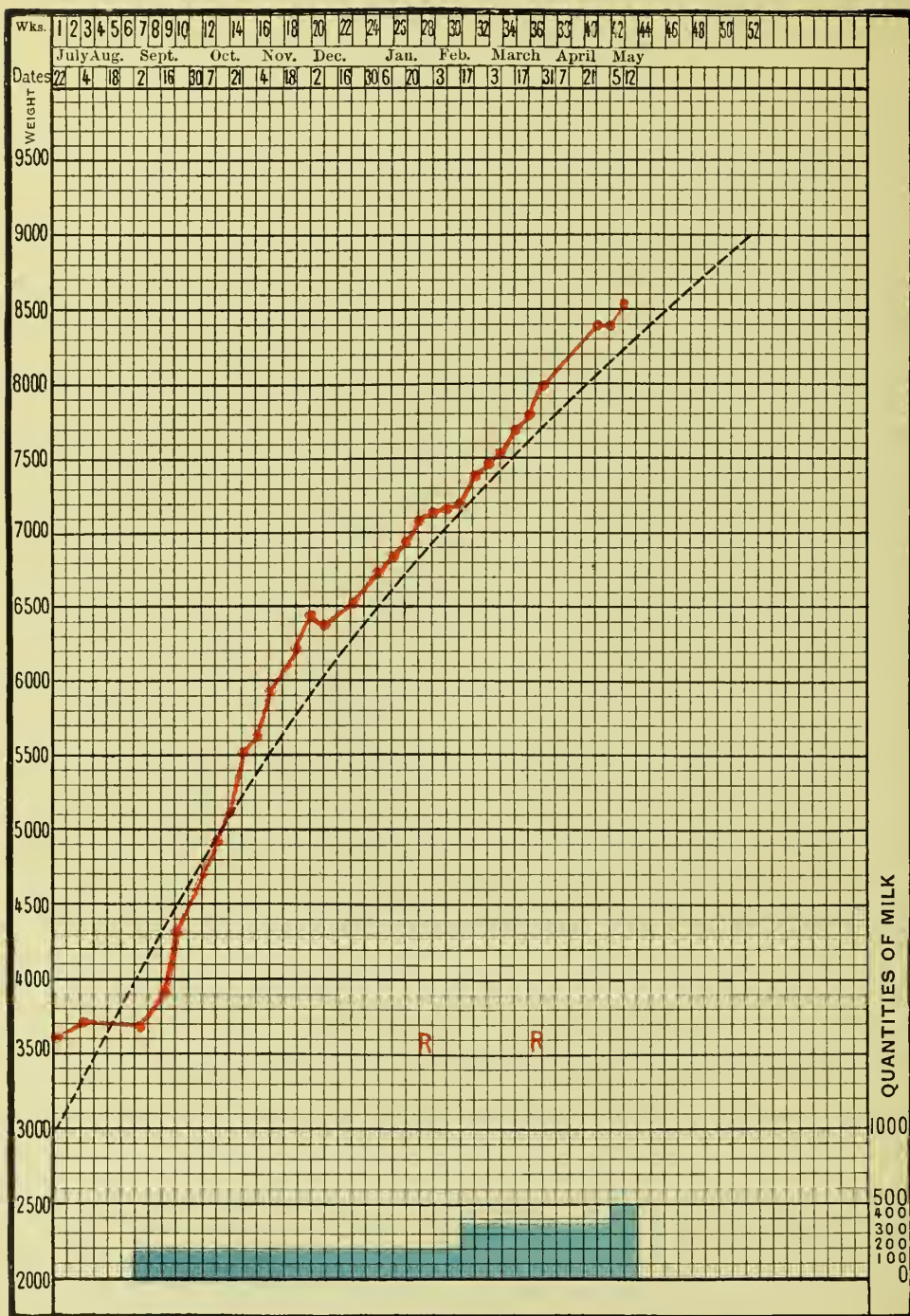


FIG. 75.—Weight curve of an infant suckled by an idiot. As she could not furnish enough milk, mixed feeding had to be adopted.

sultation. She was delivered here on July 22, 1898. Her facial expression and general appearance showed her to be a *minus habens*, almost an idiot. She left the Clinique on August 6, her baby then weighing 3800 grams. During her convalescence at Vesinet she had not sufficient milk for her infant's needs ; cows' milk was given, with the result that the infant had diarrhoea. When it returned to me on August 27 it did not weigh more than 3740 grams (Fig. 75). I continued the breast-feeding, and added per day four bottles of 50 grams, *i.e.* 200 grams of pure sterilised milk. At once the child markedly improved, and, as you see, its curve became superior to the normal. Later, the infant's progress slowed and the mother's milk became less, so I increased the amount of sterilised milk to 400 grams on February 17, 1899, and to 480 grams on May 5.

You have seen another case, that of the woman Tel——, delivered at the Maternité in 1896. From the beginning her milk supply was insufficient, and, as it soon ceased altogether, we had recourse to artificial feeding. This woman was practically devoid of intelligence ; she rarely seemed to be conscious of her surroundings ; she wandered about not knowing where she went, but she always found the way to the Maternité. Every day she came to seek her infant's allowance of milk, and faithfully appeared with her little one at the times appointed for the Consultation. She kept her baby very clean and free from harm, and its weight followed practically the normal curve.

You will sometimes have difficulty in persuading women who are mentally unsound to obey your counsels. Your efforts, however, are reinforced by their powerful maternal instincts, and a little patience will enable you successfully to surmount all obstacles. The infant is better cared for than if it were confided to a mercenary stranger, and the mother, although incapable of work, at least renders the service to society of rearing her own child.

## LECTURE VII

SUMMARY :—Infants who cannot suck.

Infants with hare lip and cleft palate.

Infants who will not suck—Infants who cannot digest human milk.

Various animal milks in common use—Asses', goats', cows'.

Qualities of a good milk—Milk in Paris—Milk distributed by the public authorities.

Methods of preserving milk—Refrigeration—Pasteurisation—Boiling—Sterilisation—Apparatus of Soxhlet, Gentile, Budin, &c.—Galactophore.

Milk rendered absolutely sterile by heating to  $110^{\circ}\text{C}.$ , or by discontinuous heating—Sterilised milk of commerce.

Mixed feeding—Its uses—Case of an infant successively put upon artificial, mixed, and breast-feeding.

How to determine the quantity of cows' milk to be added to the mother's supply—Use of the balance as a guide.

GENTLEMEN,

In our last lecture we studied various conditions in which it is still a vexed question whether breast-feeding should be encouraged or not. There are others, however, in which we have no option—such as those in which congenital malformation prevents an infant from exercising the suction necessary to extract the milk from the mother's breast. Here we are compelled to have recourse to artificial feeding.

For example, on March 17, 1893, an infant was born in the Clinique with a hare lip and cleft palate. As it was absolutely impossible for him to be suckled, he was fed from the first on undiluted sterilised milk with excellent results. When three days old he weighed 2825 grams, and, when seventeen weeks, 6925 grams. He had thus increased by 4100 grams, or, on an average, 39 grams daily. His curve was quite superior to the normal (Fig. 76). He progressed in such a fashion that at the seventh month, when the malformation was surgically treated, he weighed 11 kilos. After a slight halt, consequent on the operation, he began once more to increase, and to-day is one of the finest children I know.

Recently, I saw another case of the same kind. As the infant was incapable of sucking, it was fed first with asses' and later with cows' milk, undiluted and sterilised (Fig. 102, p. 129).

Strange to say, there are infants who will not take the breast. This abstinence is sometimes only temporary, but occasionally it is permanent. You have just seen in the wards a case of a full-term, well-developed infant whom, at the beginning, we could get to accept nourishment only by means of gavage; he afterwards consented to be fed from a spoon, and some days later to be suckled by his mother. As we had meanwhile given another infant to her to nurse, her mammary secretion was fully established, and she was able herself to rear her child.

On November 6, 1893, I assisted at the delivery of a strangely wayward infant. He was perfectly developed in every particular, except that the roof of his mouth was slightly more arched than usual. He sucked a little at first, but soon altogether refused the breast. Several wet-nurses were tried without success. On November 14 the infant weighed 3030 grams. On November 15, as he would take only 248 grams from the breast, he was given asses' milk in addition. The details of his feeding were as follows:—

Date.	Breast Milk.	Asses' Milk.	Total.
November 15 . . .	248 grams	300 grams	548 grams
" 16 . . .	270 "	380 "	650 "
" 17 . . .	318 "	220 "	538 "
" 18 . . .	195 "	490 "	685 "
" 19 . . .	0 "	700 "	700 "

A second wet-nurse was obtained; as her own child became ill she had to leave, and a third was immediately chosen:—

Date.	Breast Milk.	Asses' Milk.	Total.
November 20 . . .	385 grams	270 grams	655 grams
" 21 . . .	160 "	505 "	665 "
" 22 . . .	120 "	575 "	695 "

On the 23rd, in spite of all persuasion, the infant would not suck. Breast-feeding having thus, perforce, to be suspended, asses' milk was given, diluted with lime-water. This mode of feeding was continued till December 2, during which time I still had hopes of ultimately persuading the infant to take the breast. I was then obliged to reconcile myself to rearing him artificially, and from



December 3 he took nothing but undiluted sterilised cows' milk. The digestive tract behaved admirably; all our difficulties disappeared, and the curve rose to surpass the normal. On April 5 the infant reached 7550 grams; as it had gained 4085 grams in 123 days its average increase was 33.2 grams per day.

Other infants quite capable of being suckled are yet unable to tolerate human milk. I published a curious example of this in 1893. A child born on February 21, 1893, with a weight of 4800 grams, did not weigh more than 4575 grams on March 2, in spite of having an excellent wet-nurse. Whenever he was suckled he became deadly pale, and between the breast-feeds he seemed to be threatened with syncope. As I was therefore obliged to feed him artificially, I prescribed asses' milk on March 5, and the wet-nurse was dispensed with; on March 9 he weighed 4820 grams. A second wet-nurse with an abundant supply of milk was procured, but, several days after, his stools became badly digested, the pallor on being suckled reappeared, and the semi-syncopal attacks again occurred. On March 16 convulsive movements were observed, and on March 19 he absolutely refused to take the breast. He was again fed exclusively on asses' milk, and this wet-nurse, like her predecessor handsomely compensated, was also allowed to go. Asses' milk succeeded very well to begin with; on April 5, at the seventh week, the infant weighed 5500 grams. But then the former symptoms reappeared; the digestion became imperfect, and the pallor and syncopal attacks recurred. Fearing that there might be some cerebral origin for these attacks, on April 8 I had a consultation with the distinguished neurologist, Dr. Simon, who expressed the opinion that the symptoms arose from purely alimentary causes. On April 10 the infant resolutely refused asses' milk. As this state of affairs persisted on the following day, I was forced to place him on cows' milk. It was sterilised, and given sometimes undiluted, sometimes with one-fourth of its bulk of water added. It was found that he always began to cry about an hour and a half after taking the diluted milk, whereas, after the pure milk he waited two hours without protest. Pure milk was then given exclusively. He thrived thenceforth, and his curve became superior to the normal (Fig. 77). When aged fifteen months he had twelve teeth and weighed 11,500 grams.

Sometimes it is not the infant but the mother who is the source of difficulty. Some women have practically no mammary secretion. They are extremely rare, but I shall have occasion,

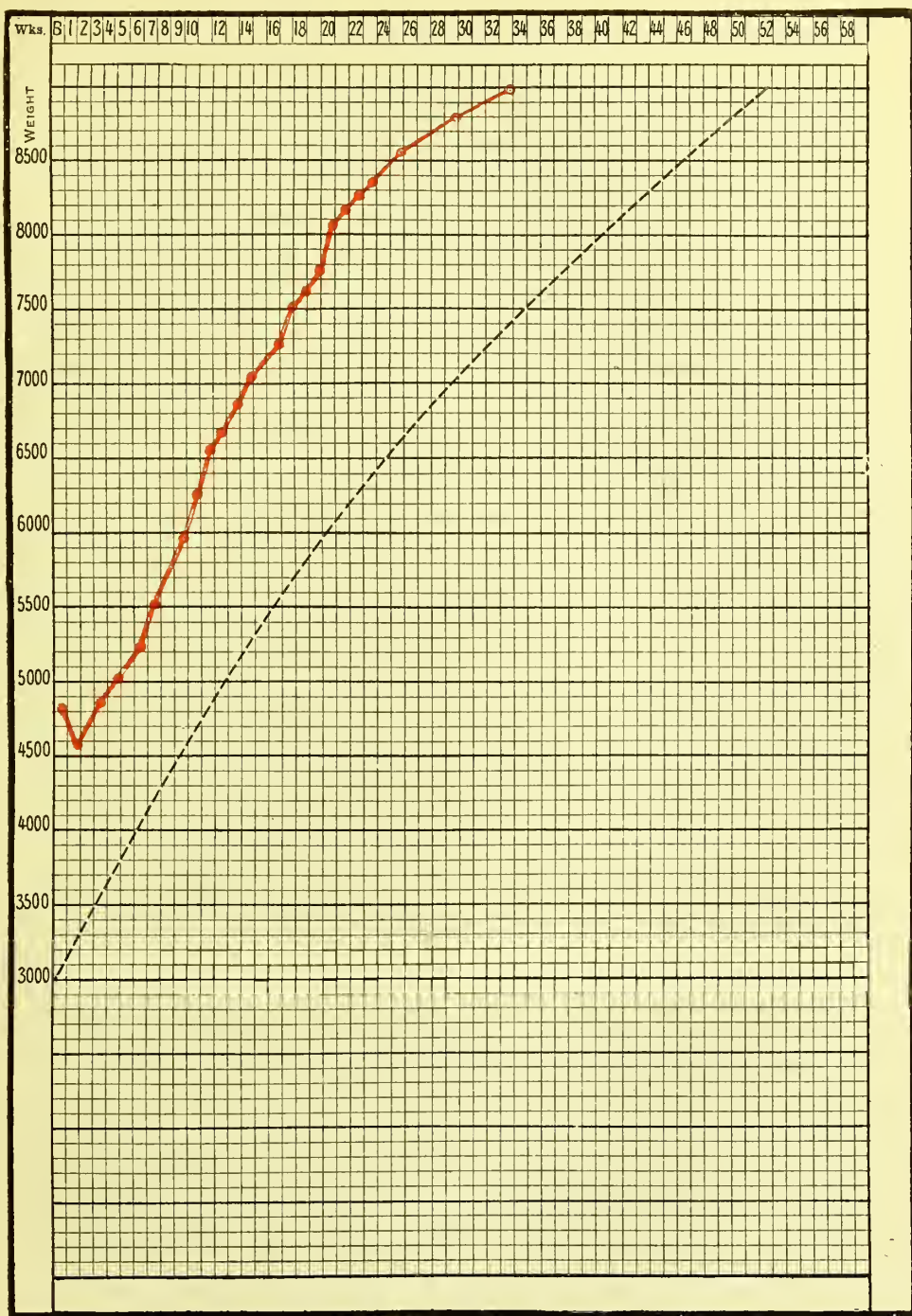


FIG. 77.—Infant who could not support human milk. Artificial feeding.



later, to report to you in detail the history of a woman, named Liv——, who had three children whom we were compelled to rear artificially as she never had any milk: her breasts were absolutely flat and her nipples umbilicated. Other women have very little milk, and are thus unable to provide sufficient for their infant's wants.

In these cases some other milk must be employed either to replace or supplement the mother's supply. Rich women employ wet-nurses, poor women use animal milk.

The different milks used are those of the ass, the goat, and the cow. Asses' milk closely approaches human milk in composition, but it is generally poor in butter. It is easily digested by the newly born, who thrive upon it; but large quantities need to be taken, and it soon becomes an inadequate diet for the growing infant (p. 129, Fig. 102). Asses are milked twice daily, in the morning and evening: the milk ought to be collected in vessels which have been thoroughly cleansed, and washed in boiling water; heated in a steriliser to about  $37^{\circ}$  C.; and then given pure, without the addition of either water or sugar. Unfortunately it is very dear, keeps badly during summer, and is liable to alteration on boiling. Hence it is but little employed.

Goats' milk is much used in some countries, and is of great value, but it is rarely obtainable in large towns.

It is upon cows' milk, therefore, that we mainly rely for infant feeding. Normally, each litre of cows' milk contains 870 parts of water and 130 parts of solids. The latter comprise—

Butter . . . . .	40
Milk sugar . . . . .	50
Casein, salts, and extractives . . . . .	40

The milk should be obtained from well-nourished, healthy cows; it should be the product of a complete milking, and it should neither be skimmed nor watered.

The cows must be healthy; tuberculosis, inflammation of the udder, apthous fever and other diseases render their milk a source of great danger to the consumer. They must be well nourished; malt and certain other food-stuffs given in excess make the milk most harmful to infants. The milk must be the product of a complete milking, for the first of the milk is generally too poor, and the last too rich, in fat. Lastly, it must be neither creamed nor diluted.

Unfortunately, in large towns, especially in Paris, these require-

ments are but rarely observed. In 1897, on the initiative of M. Paul Strauss, a commission was appointed for the study of milk as a food. The municipal laboratory took, at random, samples of the milk offered for sale in each of the twenty districts of Paris. These specimens were analysed, and here I have depicted graphically the quantity of butter found in each (Fig. 78). The first column, that coloured red, corresponds to a normal milk with 40 grams of butter per litre. All the other columns are smaller; only 6 contained more than 30 grams of butter per litre; 14 had less than 30; and in certain samples we found as little as 19, 17, and even 15 grams. The uncoloured part of each column represents the deficiency in butter, 40 grams per litre being taken as the average. All the milks had been skimmed; the best of them was still without 10 per cent. of the fat; but in some the skimming had removed 41, 43, 45, 47, 49, and even 59 per cent. of the normal amount of butter. In some instances not only was part of the cream wanting, but the milk had also been watered.

I had previously made a similar examination in one of the poor quarters of the city, from which infants were arriving at the Consultation, obviously underfed, although their mothers asserted they were giving them milk in quantities which should have been amply sufficient. Samples of milk were obtained from the various dairies patronised by these women. Here is a graphic reproduction of the results of analyses of so-called milks taken from forty-five different sources (Fig. 79).

Numbers 1 and 2 cost twopence per litre; 3 to 36 inclusive, twopence-halfpenny; and 37 to 45, threepence.

Samples.	Butter contained per litre in grams.	Samples.	Butter contained per litre in grams.
1 . . . . .	37	2 . . . . .	25
4 . . . . .	32	2 . . . . .	24
3 . . . . .	31	5 . . . . .	23
6 . . . . .	30	2 . . . . .	22
4 . . . . .	29	3 . . . . .	19
2 . . . . .	28	2 . . . . .	17
3 . . . . .	27	1 . . . . .	16
4 . . . . .	26	1 . . . . .	15

Only once, No. 38, did the milk contain 37 grams of butter; this specimen was sold for threepence per litre by a dairyman who had just begun business. Seven times it reached 31 or 32 grams, and the remaining thirty-seven samples gave 30 grams, or considerably less.



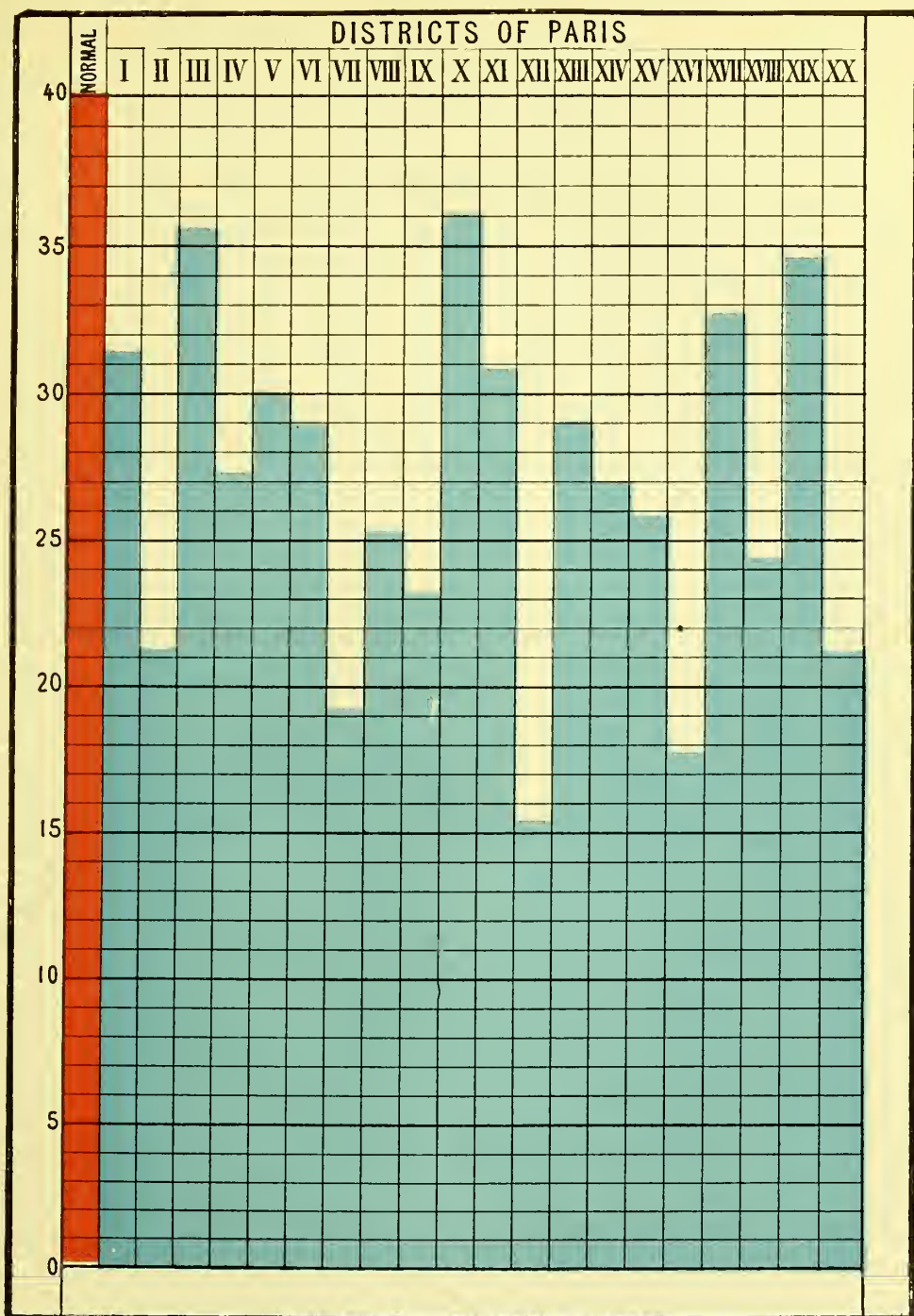


FIG. 78.—Result of analysis of the milk-supply of Paris on June 1, 1878. Columns showing the quantities of butter contained in samples of milk from the various districts.





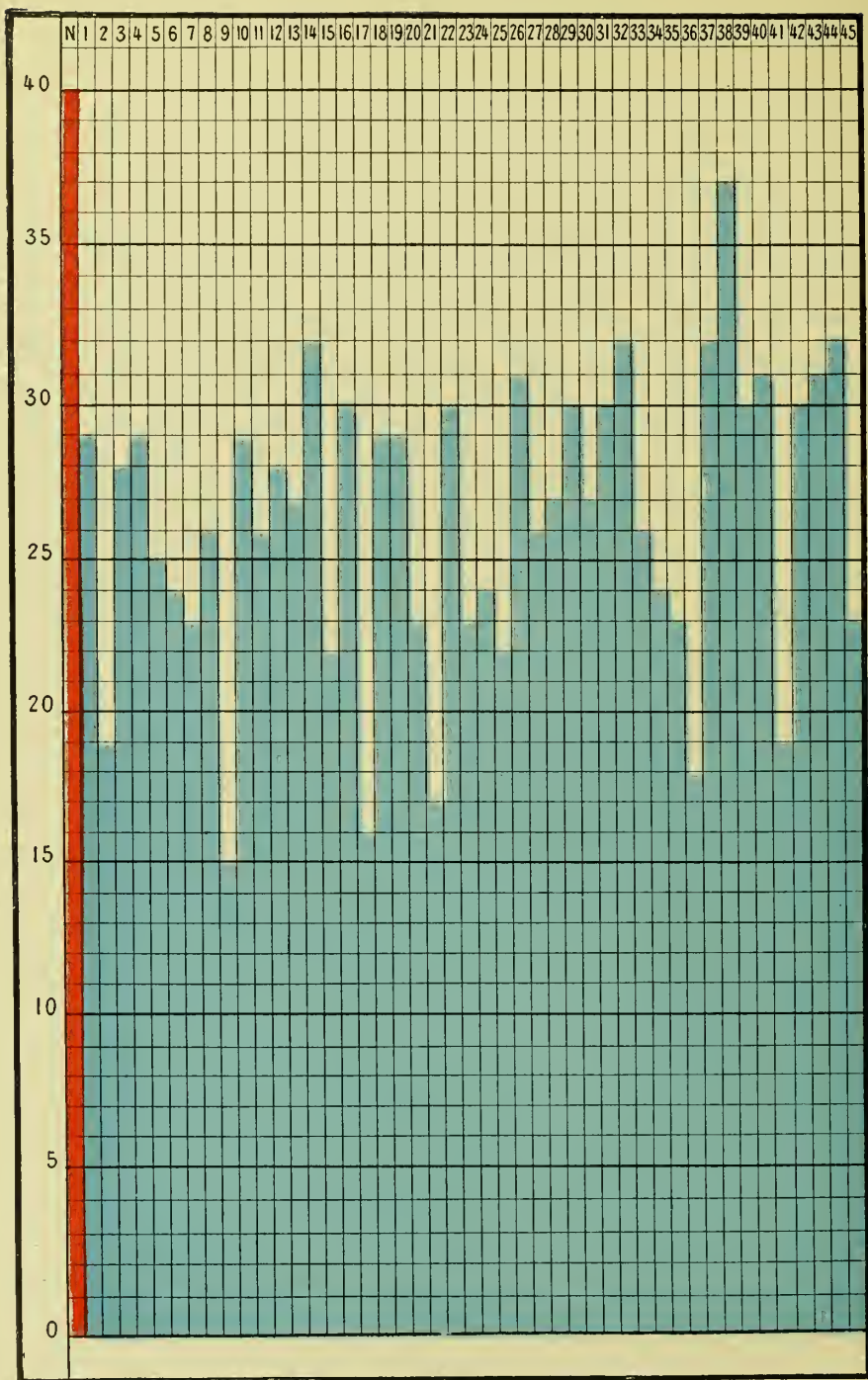


FIG. 79.—Quantities of butter contained in forty-five samples of milk collected from a poor quarter of Paris (Rothschild).

Think of the deplorable consequences of the use of such milk for infants and invalids. How can an infant thrive on milks which contain only 19, 17, 16, or 15 grams of butter? He requires to drink a certain bulk of pure milk to obtain the necessary amount of fat. But with liquids such as these he will have to ingest two or three times that volume, which is not only a great inconvenience, but also a menace to the infant's health. Further, mothers, believing they have bought pure milk, consider it their duty to dilute these lacteal fluids with water.

The hospital milk is happily of good quality. The dairymen supply it, on contract, to the public authorities, who supervise it rigorously; it is analysed daily, and, till 1898, had to contain 27 grams of butter per litre, but since that year the standard has been raised to 38 grams.

Pasteur and his pupils have demonstrated the dangers of milk as a carrier of infection. Bacteria develop in it with extreme facility. Some of these bacteria, as we have already seen, originate in cows affected with contagious diseases; others come from extraneous sources, such as the air, the milking fingers, or the water used to cleanse the milk vessels or to dilute the milk. Introduced into the digestive tube, these organisms multiply, and may give rise to serious disturbances. Diarrhœas, including infantile cholera, the death-scurge of infants during summer, are caused by microbes.

The milk must, therefore, be maintained unaltered between the time of milking and that of use; and it must, in addition, be rendered inoffensive by making it sterile through the destruction of any germs it may contain.

To achieve these ends many plans have been devised.

The chemical methods of preservation should be discarded. To add bicarbonate of soda, formalin, and such substances to milk is equivalent to fraud, and is, moreover, a danger to the public health.

Preservation can be greatly aided by cold; this is, however, not only relatively a costly process, but it also leaves the microbes intact. The following is the method of refrigeration at present employed:—

A hollow metal cylinder is filled with water, which, by being reduced to freezing-point, is converted into ice. The cylinder with its contents is then inserted into a can of milk, which is accurately closed by the lid-like formation of the upper part of the cylinder. As the milk surrounding the ice-containing cylinder is thus main-



tained at a low temperature for many hours, it can be conveyed long distances in excellent preservation.

Cold does not destroy either pathogenic or non-pathogenic organisms. Heat is the bactericidal agent generally used for milk, and it is applied chiefly by the methods of pasteurisation and sterilisation.

In pasteurisation the liquid is heated once to about  $60^{\circ}$  C., and then rapidly cooled. This method enables the milk to be sent long distances; it retards the multiplication of germs, but does not kill them: as milk thus treated is not sterile, neither is it harmless.

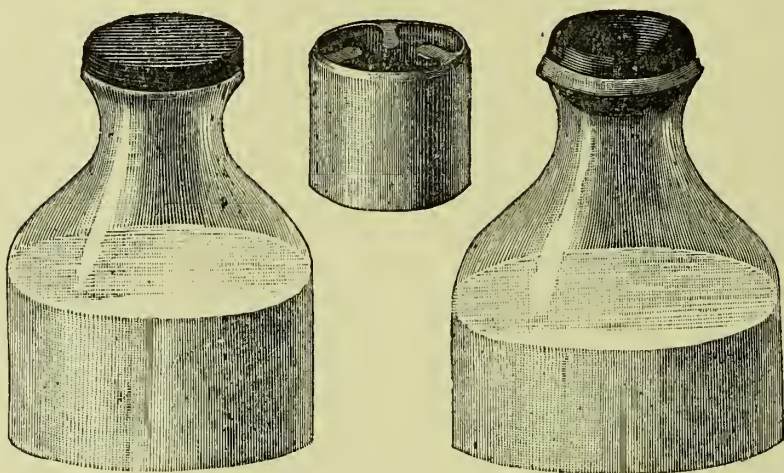


FIG. 80.—On the left: upper part of a wide-mouthed bottle, with indiarubber disc in place. In the middle: metallic capsule for keeping the disc in position. On the right: disc after sterilisation, showing the effect of atmospheric pressure.

Sterilisation of milk may be achieved in various ways: the milk may be boiled; heated in closed vessels to  $100^{\circ}$  C. for forty-five minutes; raised to  $110^{\circ}$  C. for a sufficient length of time; or subjected to discontinuous heating.

It should be boiled as soon as possible after milking, and kept in, and sold from, the vessel in which it has been boiled.

It is customary to boil the milk in an open vessel; before being covered it must first be allowed to cool, otherwise the steam would condense on the cold lid in droplets, which, in running back, would carry into the milk organisms and impurities. If the milk be

covered whilst hot, the lid must first be thoroughly cleansed in boiling water.

Boiling kills nearly all germs. Some, however, escape, and under favourable conditions of temperature can multiply and bring about changes in the milk. Milk, therefore, must not be placed in overheated rooms, and, especially during summer, ought to be used soon after it has been boiled.

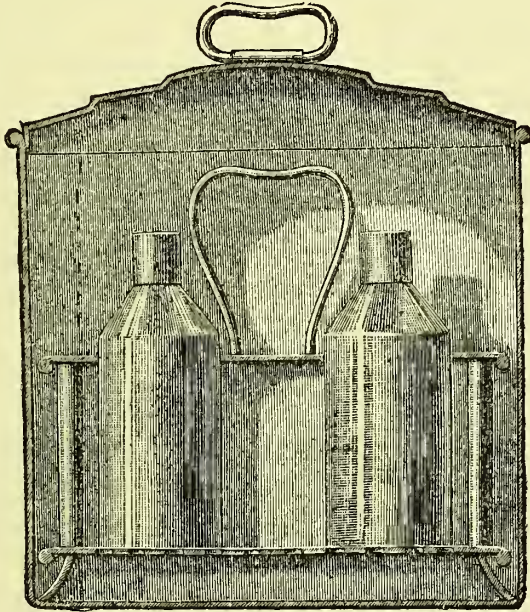


FIG. 81.—Section of a milk steriliser, showing bottles with discs and capsules in position, resting on a metal support.

The milk may be heated in closed vessels in a steriliser at  $100^{\circ}$  C. Soxhlet recommended that milk destined for infants should be distributed in small bottles, each containing the supply necessary for one feed only, and in quantities determined by the number of the infant's daily meals. He used bottles the mouths of which were planed so as to ensure the accurate adaptation of the stopper he devised (Figs. 80 and 81). They were maintained upright in a metal basket, and placed in a vessel containing cold water. The water having been raised to boiling-point, and kept at that temperature for three-quarters of an hour, the basket of

bottles was withdrawn. A relative vacuum developed within each bottle on cooling, so that, the stopper having become more and more firmly applied, the bottle was hermetically sealed.

When a meal has to be given, one of these bottles is warmed, the stopper detached, and an indiarubber teat put on. No germs have been able to reach the milk, and it passes to the infant's stomach as pure as that which flows from a mother's breast.

Soxhlet's apparatus is ingenious; the apportioning of the milk into quantities for single feeds and the automatic closure of the bottles constitute a great advance. But it is not without its drawbacks. The indiarubber disc of the stopper soon stretches, and by rubbing against the metallic capsule becomes slippery, so that

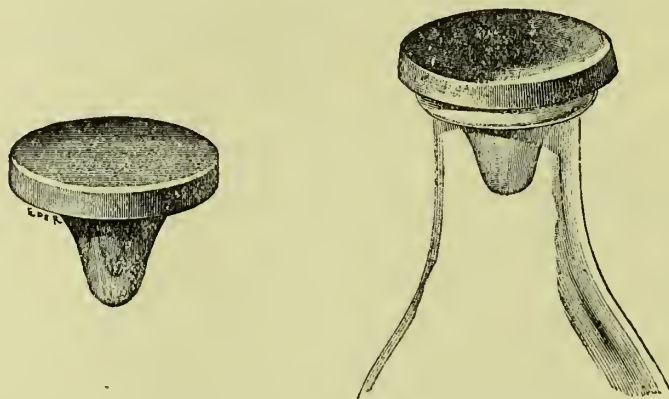


FIG. 82.—Indiarubber stopper. On the right: stopper in position on bottle after sterilisation. The central depression shows that a vacuum exists in the bottle.

it does not remain in position when the bottles are left to cool, and is easily displaced by any slight jar during transportation. Neither does the disc continue to adhere tightly if there is any crack or unevenness in the planed margin of the neck of the bottle. In my experience the operation fails in one or two out of every ten or twelve bottles thus sterilised.

Hence several analogous inventions have since been devised to overcome these defects.

Gentile's has all the advantages without the disadvantages of Soxhlet's. It consists of a plated metal steriliser with a stand for the bottles; graduated bottles; and automatic stoppers.

The steriliser is made in various sizes and, according to its

dimensions, is provided with a stand to contain five, ten, or twenty-five bottles.

The bottles are graduated in 25 grams; they contain varying amounts—50, 100, 150, or 200 grams, according to the infant's age. There is a large planed margin round the mouth of each bottle.

The automatic stopper is a small red indiarubber disc, on the under surface of which is a central appendage (Fig. 82).

The quantity of milk necessary for a single meal is poured

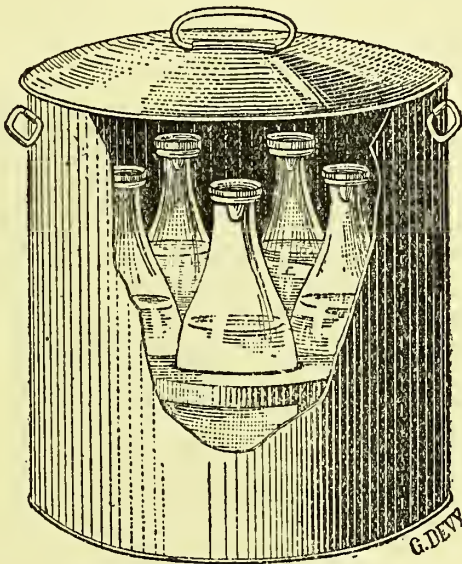


FIG. 83.—Gentile's apparatus.

into each bottle and a stopper applied. All the bottles thus prepared are placed in the metal support, which is then put into the steriliser, the cold water in which ought to reach the level of the milk in the bottles (Fig. 83). After the lid has been put on, the whole apparatus is heated over a gas burner; the temperature of the water is raised to boiling-point, where it is maintained for forty-five minutes. This having been done, and the lid raised, the bottle-stand is taken out and allowed to cool. As the temperature falls the stoppers adhere firmly. As the condensation of the water vapour, which during boiling replaced the air within the bottles, gives rise to a relative vacuum, the stopper is thus fixed by the



atmospheric pressure on its upper surface, and can be seen to become depressed in the centre as the cooling progresses.

Examination enables one easily to ascertain if this vacuum exists and, hence, if sterilisation has been effected: 1st, the disc of the stopper should adhere tightly to the mouth of the bottle; 2nd, on its upper surface there should be a central depression; 3rd, the water-hammer phenomenon should be present. To elicit this the bottle is held in the left hand; it is then turned upside down, while the bottom is sharply struck with the ulnar border of the right hand: the liquid, displaced by the blow, hurls itself *en masse* against the sides of the bottle, producing a peculiar and characteristic sound.

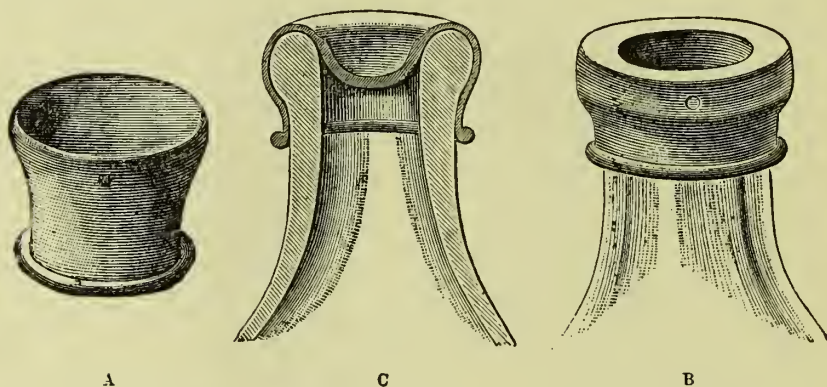


FIG. 84.—A, indiarubber hood. B, appearance after sterilisation. C, section of hood and bottle.

Before the infant is fed the milk is heated by placing the bottle in warm water. One of the edges of the stopper is then raised, and air rushes in with a hissing noise. The contents should be tasted, so as to make sure that the milk is of normal flavour, and neither too hot nor too cold. A teat or a galactophore (Fig. 86) is applied directly to the neck of the bottle, and then the infant is fed.

The bottle mouths in Soxhlet's and Gentile's apparatus have planed margins. Not only is their cost thus increased, but if the slightest irregularity exists on this smoothed edge, the indiarubber disc will not adhere on cooling.

I tried to do away with these special bottles, for, although they may be obtained more or less easily in large towns, they can only



be got with difficulty in country districts. I desired also to cheapen the process of sterilisation, for at first the necessary appliances were somewhat costly. I made indiarubber hoods like the metallic capsules which are used on many mineral water bottles. The summit of the hood is hollowed, and at the bottom of the depression the indiarubber is specially strengthened. The free margin of the part

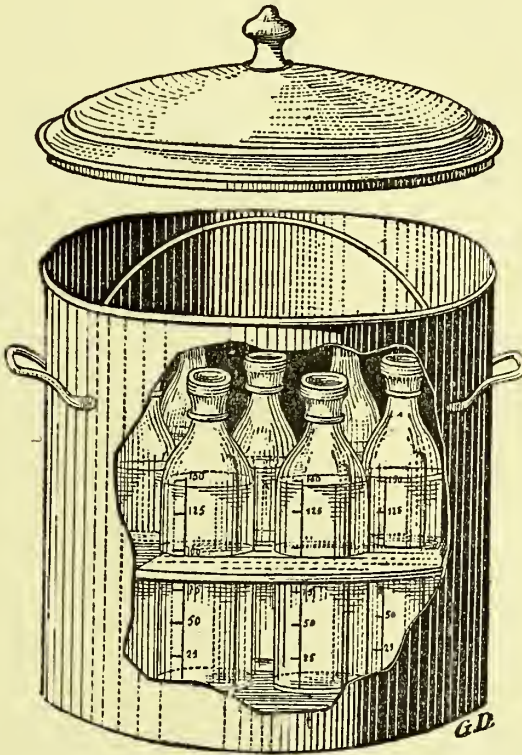


FIG. 85.—Budin's apparatus for sterilisation.

which encircles the neck of the bottle is thickened in the form of a ring (Fig. 84). Any small bottle will serve, such as is used by druggists, for example. It should be two-thirds or three-quarters filled with milk, covered with the indiarubber hood, and then placed in the steriliser (Fig. 85).

Under the influence of heat the milk gives off water vapour, which raises the depressed portion of the hood. To prevent its being entirely lifted off, two small holes are made near the top of the

part which encircles the neck. A vacuum is produced inside the bottle on cooling, and the part of the hood over its mouth is bulged inwards so that the bottle is hermetically sealed by atmospheric pressure (Fig. 84 B and C).

These hoods have the advantage of being applicable to any small bottle whatsoever, but they have certain small inconveniences;

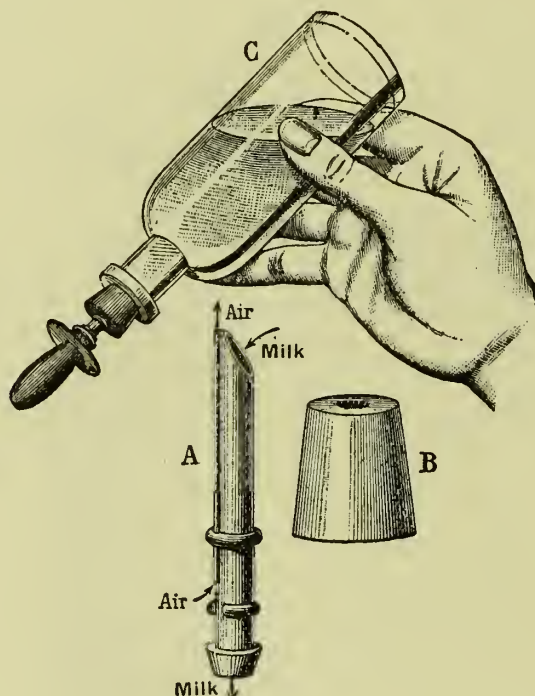


FIG. 86.—The galactophore for artificial feeding. A, tubes for the passage of air and of milk. B, indiarubber stopper by which the instrument is fixed in the neck of a bottle. C, bottle containing milk, showing the galactophore furnished with a teat.

when the bottles are taken out of the steriliser it is often necessary to readjust the hoods so as to ensure the complete closure of the bottles, and, further, the vacuum is not quite perfect, for air slowly filters in. However, the sterilisation amply suffices for twenty-four hours; during the height of summer I have seen milk thus prepared remain unaltered for weeks. Bottles sealed in this fashion can be transported with absolute safety.

Before feeding the infant the milk should be warmed, the hood

removed, and a teat or a galactophore applied (Fig. 86). The whole apparatus is simple and cheap. The bottles may be had graduated, so that the milk may be dispensed in the quantities necessary for each feed.

I first devised these hoods in June 1892, but I carefully refrained from making them known, for I thought that it was not conducive to the spread of the practice of milk sterilisation to multiply the number of apparatus. Their existence was known only to four persons, and I continued to recommend the inventions of Soxhlet and of Gentile. Imagine my surprise one day, about a year later, when I saw a prospectus lauding their merits and advertising their sale. As my confidants were no less astonished than I, an explanation was demanded from the indiarubber manufacturer, who was the only other person cognisant of them. I threatened to prosecute him. "I confess I am to blame," said he, "but let me explain how it happened. One of my children, bottle-fed, was stricken with diarrhoea and like to die. I had made these hoods for you and knew their purpose. I took several of them, and sterilised the milk given to my little one. His symptoms abated, and he gradually recovered. As I knew the prohibitive cost of the milk-sterilising apparatus on the market, I resolved to make and sell these hoods at the lowest possible price, so as to bring them within reach of the poor, and thus add my feeble efforts to the protection of infant life. I do not seek for gain, I wish only to further this work of humanity. I beg of you to let me continue. You will find the poor will have no cause to regret it." I dared not refuse. It was thus my invention was popularised almost in spite of myself.

Nowadays systems without number, each more simple, more ingenious than the other, are manufactured on every side; nearly all are valuable. Competition has brought about the cheapness I so greatly desired to attain, and the only remaining difficulty is the embarrassment of making a choice.

In default of special stoppers there is yet another way of making use of ordinary small bottles. They are thoroughly washed and left to drip. The requisite quantity of milk is poured in, and they are closed by plugs of cotton wool or pieces of linen fastened over their mouths. Then they are placed in a special metal support, and, as before, introduced into a steriliser.

If it be considered needful to dilute the milk, this should be done before sterilisation.

Any milk remaining in a bottle after a feed ought not to be again offered to the infant, for it is no longer sterile. The organisms of the mouth, entering the bottle through the teat, rapidly multiply, and produce alterations in the milk.

Every bottle emptied ought at once to be thoroughly washed. Soap or carbonate of soda added to the water facilitates the removal of fatty particles. After being washed the bottles should be carefully rinsed. This cleansing is of great importance, for dregs of milk become soured and contaminate any fresh supply put into the bottle.

The sterilised milk in these small bottles should be used within twenty-four hours.

If one or more bottles have not been opened, and it is desired to use them on the following day, they must be re-sterilised.

These different procedures give not an absolute but a relative sterilisation. When milk has to be preserved for more than twenty-four hours it must be freed from all living organisms. This is done either by discontinuous heating below  $100^{\circ}$  C., or by one prolonged exposure to  $110^{\circ}$  C. Discontinuous heating is costly, and hence but little used. Sterilisation at  $110^{\circ}$  C. is widely practised. Milk thus treated is sold in half-litre and in one-litre bottles. It is also dispensed in smaller bottles, each containing the equivalent of one feed—40, 50, 60, 75, 100 grams, &c. These bottles are corked, and each cork should bear a stamp with the date of sterilisation, so that the consumer may know when it was prepared.

Before such milk is used it ought to be rigorously examined to make sure—(1) that it is of normal appearance, neither curdled nor dark in colour; (2) that on opening the bottle the contents are sweet-smelling and do not liberate any gas; and (3) that the liquid has the usual taste of milk.

Cream that has risen to the surface should be put in suspension by shaking after the milk is warmed. The milk should be poured directly into a scrupulously clean feeding-bottle. If it has to be diluted, boiled water should be used. If the small one-feed bottles are employed, it is necessary only to remove the cork and fix a teat on the neck.

Weber, Michel, and others have shown that sterilisation has no deleterious influence on the nutritive value of the milk. I need hardly say that the milk which is sterilised must be of good quality, and contain the requisite amount of nutritive matter. I once received a gracious gift of a hundred bottles of sterilised



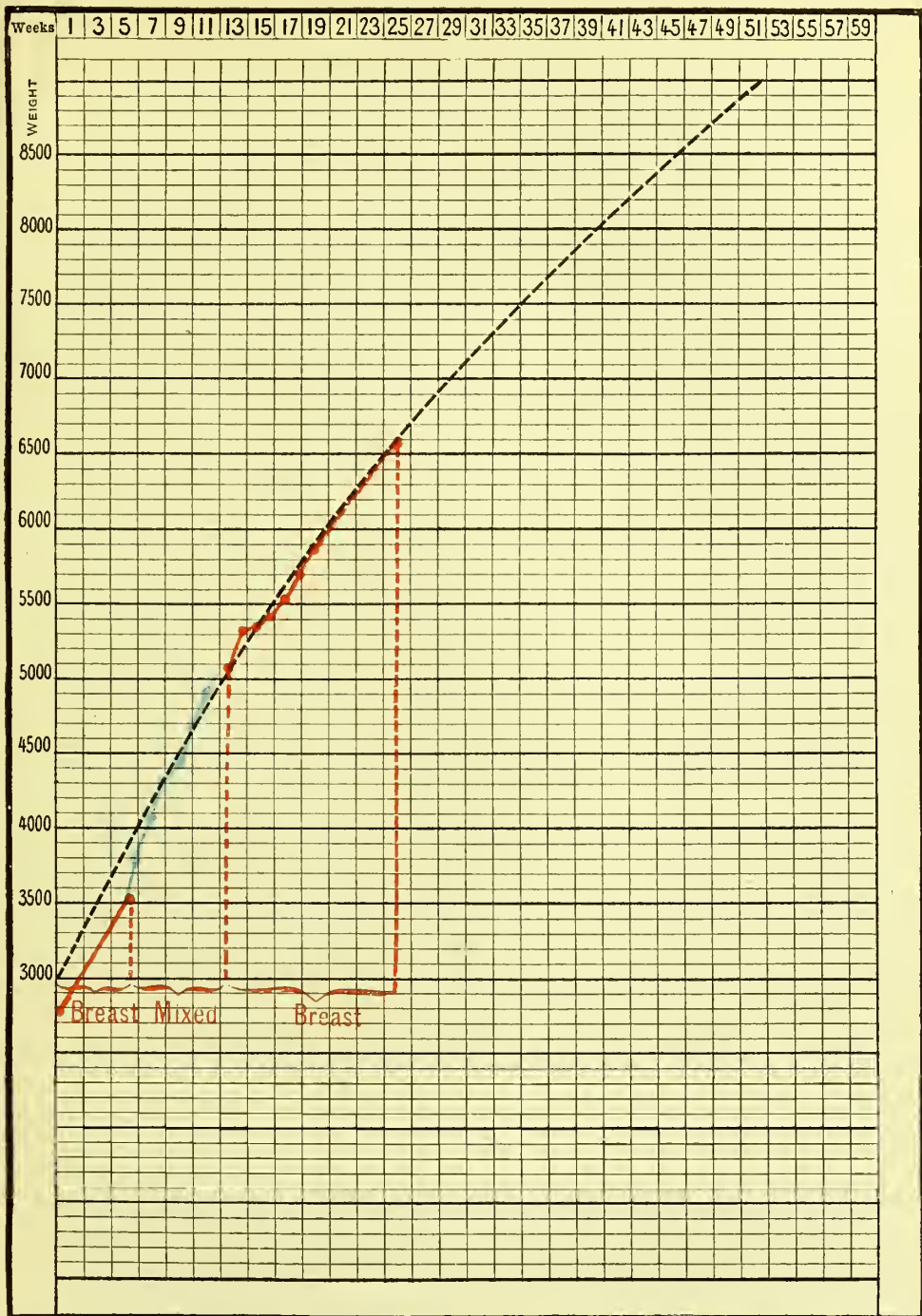


FIG. 87.—Maternal feeding at first insufficient. Mixed feeding temporarily practised. When the mammary secretion became more abundant, the child was exclusively breast-fed.





milk for the use of the women and children in the hospital. The milk did not come from the neighbourhood of Paris. On analysing it I found that it contained only from 7 to 9 grams of butter per litre instead of 40.

Having discussed the preparation, distribution and properties of sterilised milk, we can now pass, gentlemen, to the study of *mixed* and *artificial* feeding.

When the maternal milk is supplemented by animal milk the feeding is said to be *mixed*. The infants of the hospital wet-nurses, as I told you, are reared in this way (p. 36). After several weeks of breast-feeding, if they are thriving they begin to get sterilised milk in progressively increasing quantities—100, 200, 300 grams per day, and so on. The infant receives less and less of its mother's milk, which is diverted more and more to the exclusive use of the weaklings. I have also told you of mothers who wished to nurse but yet had not, at first, enough milk, and how we supplemented their efforts either by asses' milk (Fig. 40 and p. 53), or by cows' milk (Fig. 50 and p. 79). Mixed feeding in these cases enabled us not only to await and encourage the maternal supply but also ultimately to ensure that the infant would be fed exclusively at the mother's breast. Therefore, do not hastily conclude that a woman will prove an inadequate nurse. A little patience on your part will save many a mother from the humiliation of employing a wet-nurse, and many a child from the danger of artificial feeding.

Let me cite to you several cases.

A woman named R——, confined at the Charité on December 31, 1892, gave birth to a child weighing 2775 grams. She had not much milk at first. When she left the hospital on January 11, 1893, the baby had attained a weight of 2940 grams. Two days later it was brought to me weighing 2990 grams, and, as it was being fed exclusively at the breast, I thought the mother was going to prove a very satisfactory nurse. On February 17, however, the infant was only 3500 grams. From birth its average daily gain had been only 15.5 grams, which was considerably below the normal (Fig. 87). I prescribed then three bottles per day, each of which contained 50 grams of sterilised milk. A marked improvement immediately followed. Early in May the mother's supply became sufficient and the sterilised milk was suppressed. This child weighed 6570 grams on July 14.

The next is rather a curious case. For some time the mother had no milk at all, and yet she ultimately became a fairly good

nurse. This woman, S——i, was prematurely delivered at the Charité of an infant, weighing 2075 grams, which was immediately put in an incubator. When the child was a few days old, an accidental burn on the left arm gave rise to a reflex diarrhoea, which lasted three days. The infant was too weak to suck; it was fed with sterilised milk from a spoon. On January 26, although the child weighed only 1950 grams, the mother insisted on going home. Next day it was found to have lost 50 grams. The mother was carefully instructed how to express the little milk she had from her breast, directly into the child's mouth. In addition, eight bottles, each of 50 grams of sterilised milk, were given daily. On February 3 the burn was nearly healed, and the infant weighed 2150 grams. As it was now beginning to suck, the quantity of sterilised milk was gradually reduced. Artificial feeding was then succeeded by mixed feeding, which, in turn, gave way on March 3 to breast-feeding. The infant's curve (Fig. 88) became superior to that of the average full-term child. Sterilised milk and mixed feeding enabled this mother to complete her maternal function.

But how is one to determine when it is necessary to supplement breast-feeding by sterilised milk; and, after being convinced as to its need, what quantities must be given? The guide is the balance. If the infant's weight is stationary or only slightly increases during a period of, for example, a week, a search should be made for any pathological condition that may account for this tardy growth. If none is discovered, and if the colour and consistency of the motions show that the assimilation is not at fault, then you will find, on weighing the infant before and after each feed, that it obtains but a small amount from the breasts, as the milk secretion is probably deficient. The child is being underfed, and the mother's supply must be reinforced by the addition of sterilised milk.

Never forget the observation I made to you in one of the earlier lectures: "It is better at first to give too little than too much. An underfed child does not increase in weight; it may even diminish; but it is free from digestive troubles, which are mainly the results of excess. The amount can be gradually and safely increased till that necessary for the satisfactory progress of the child is reached."

I can best demonstrate my usual mode of procedure by giving you a few examples.

A woman named Guill——, delivered on June 16, 1896, left the hospital on June 26, when her infant weighed 3940 grams.

On July 11 it was only 4070 grams. Its average daily increase

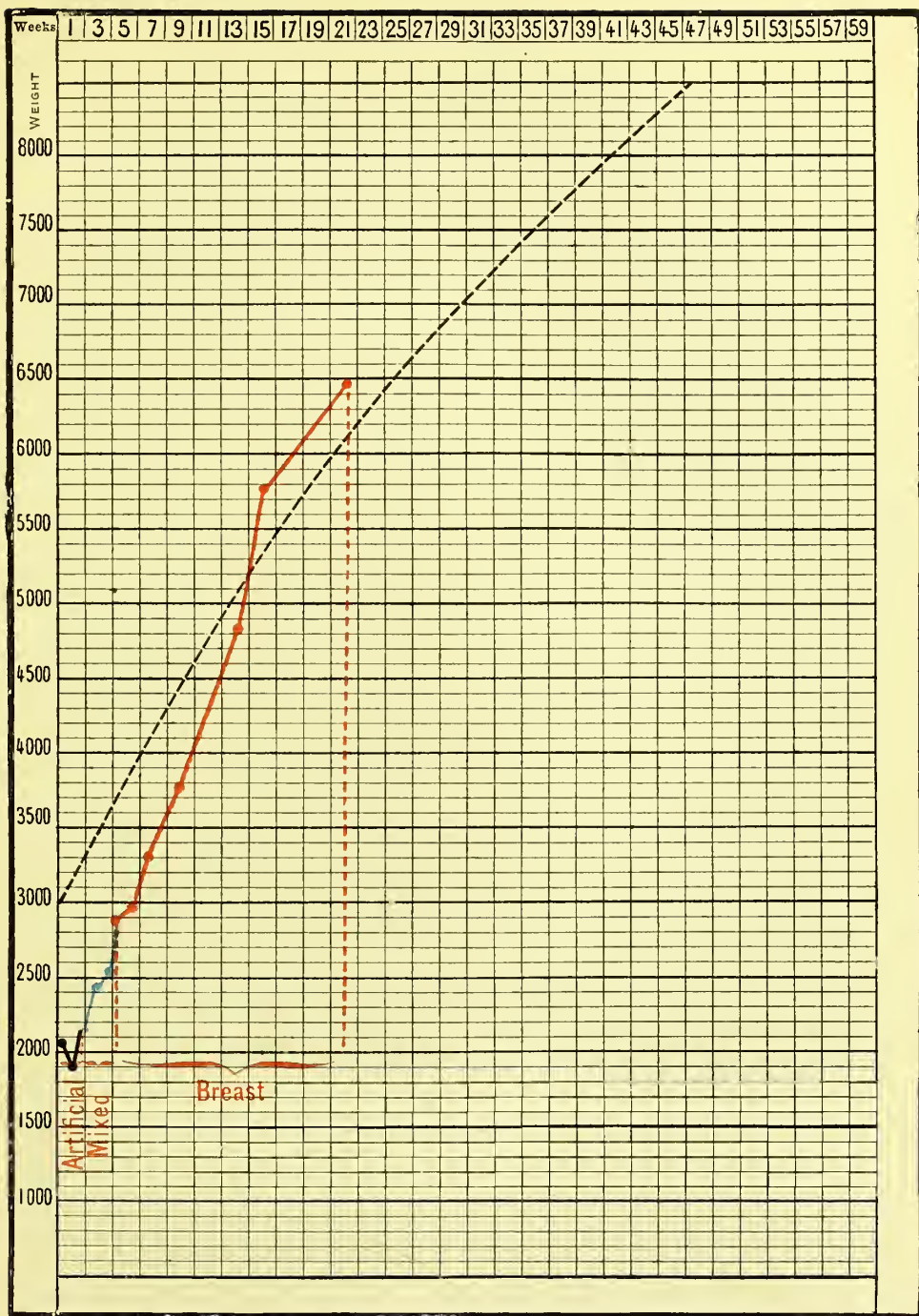


FIG. 88.—Curve of a weakling who was first placed upon artificial feeding, then upon mixed feeding, and then upon breast-feeding exclusively. The mother, who had no milk at the beginning, ultimately proved an excellent nurse.







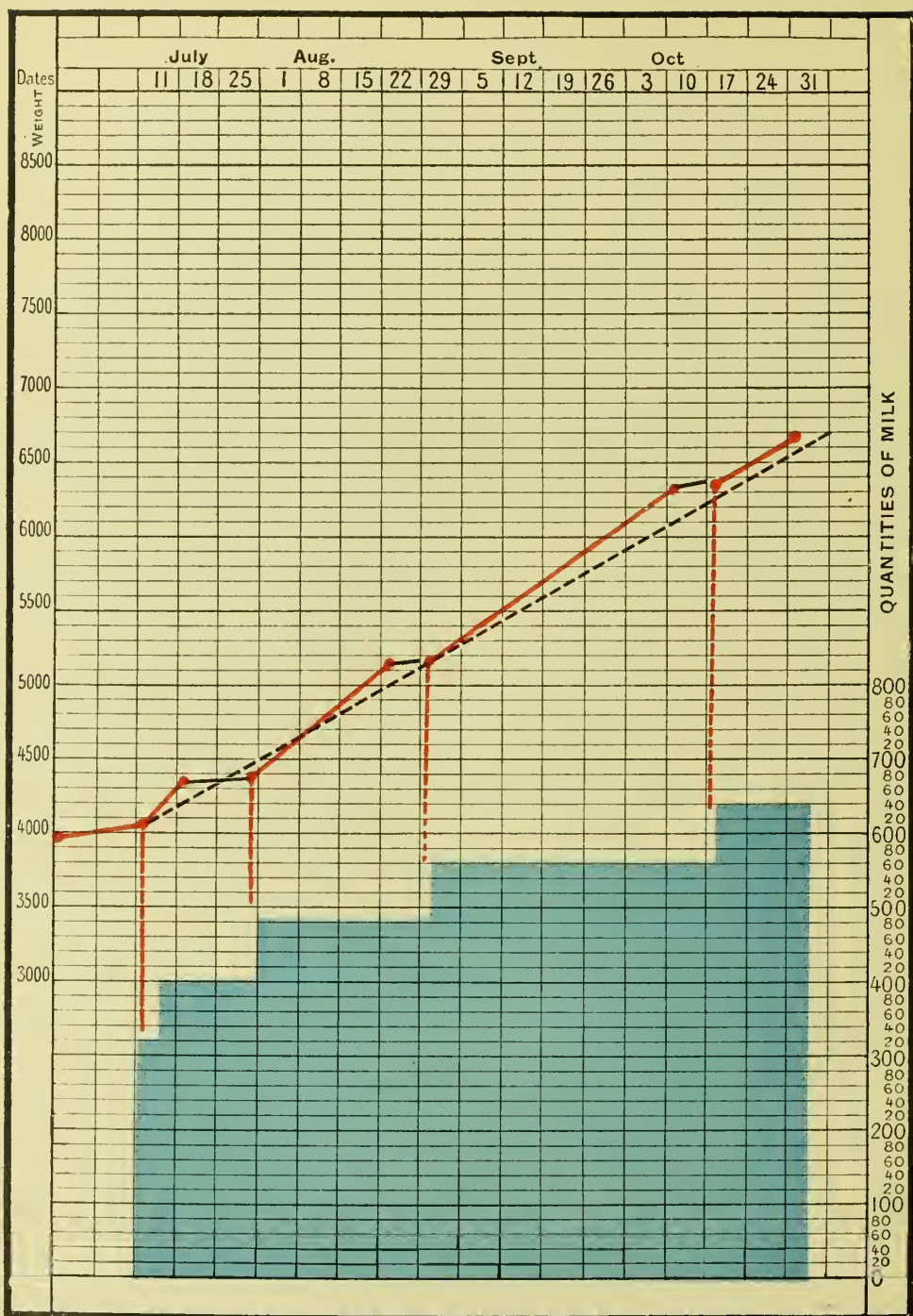


FIG. 89.—Curve showing how the quantity of cows' milk has to be increased in mixed feeding.

had been 8.5 grams (Fig. 89). After July 13, as the mother's milk was becoming less abundant, sterilised milk was added to the infant's diet in quantities of 320 and, later, of 400 grams per day. On July 18 the infant weighed 4310 grams. In one week it had increased by 240 grams, or at the daily rate of 34.2 grams. On July 28 he was found to have gained only 60 grams in the ten days. The mother's milk, I thought, was probably still diminishing. As weighing the child before and after each breast-feed proved this to be the fact, the sterilised milk was increased to 480 grams per day. On August 22 he was found to weigh 5120 grams. He had, since his diet was increased, gained on an average 31 grams per day. As on August 29 he was only 5160 grams, his daily allowance of sterilised milk was raised to 560 grams. On October 10 he weighed 6310 grams, and had thus gained 1150 grams in forty-two days. On October 17 his rate of growth was found to have again diminished. In the week which had elapsed since the last weighing his average increase had been only 9.4 grams per day. As the mother's supply was steadily dwindling, the supplement was then raised to 640 grams per day, and a fortnight later his weight had increased by 310 grams. And so the history continues. The mother secreted less and less milk, and thus, from time to time, as the child paused in its growth, the sterilised milk had to be increased until the feeding became exclusively artificial.

A woman, by name Mor——, delivered on June 21, 1896, left hospital on July 1, with her infant weighing 3900 grams. On July 4, on being brought by her to the Consultation for Nurslings, he was found to weigh only 3720 grams; he had lost 180 grams. As I was still hopeful that the mother might yet furnish enough milk, I resolved to delay interference. On July 18 the infant was 3800 grams (Fig. 90). The amount of his daily increase was altogether insufficient, as it had been only 5.7 grams. I then gave 150 grams of sterilised milk per day. The infant rapidly gained. On August 8 he was 4580 grams. During these three weeks he had increased on an average by 37 grams per day. In the first week the average daily gain was 45.7 grams, in the second 37.5, and in the third 28.5. It looked as if the mother's supply was diminishing rapidly. On August 15 the infant weighed 4560 grams. As there had been a loss of 20 grams in seven days, his daily ration of sterilised milk was raised to 200 grams. This had the desired effect, for on September 19 the child had attained 5450 grams. On that day an accident befell the mother, and her

milk completely disappeared. The infant was given 400 grams of sterilised milk per day. The amount was rather small for one of his weight, but by underfeeding slightly I hoped to stimulate his zeal for sucking, so that the mother's milk might be lured back. On September 26 he was found to have increased by only 50 grams in seven days. As his growth was suffering from his meagre diet, I raised his daily allowance to 640 grams. He gained rapidly. On October 17 he weighed 6230 grams. During these twenty-one days his average daily increase was 34 grams.

In these two cases the mothers were but mediocre nurses, and their milk, in spite of all our endeavours, gradually disappeared. In others I have happily met with more success. By improving the mother's general health her milk supply is often rendered more and more abundant, until she becomes capable of amply providing for her infant's nourishment. Then cows' milk may be dispensed with, and the child reared exclusively at the breast. Here again the balance guides the withdrawal of the sterilised milk. The following is a typical history of a successful case.

A woman named Pouc—— was delivered on November 14, 1897. On December 18 the infant came under my care; he weighed 4070 grams. The mother having had mastitis, gave only one breast. I advised her to suckle with both, and prescribed 250 grams of sterilised milk for the child. On December 24 he weighed 4400 grams. His increase, averaging 55 grams daily, amounted to 330 grams in six days (Fig. 91). As the quantity of sterilised milk was obviously more than sufficient, it was reduced to 200 grams. On December 31 the infant weighed 4650 grams. As he had gained 250 grams in one week, his growth was still considerable. The average daily increase of 36 grams being in excess of the normal, the sterilised milk was still further diminished to 140 grams per day.

On January 8 he weighed 4880 grams. During these eight days he had increased on an average by 29 grams per day, so I resolved totally to suppress the sterilised milk, hoping that the mother would yield sufficient for the infant's needs. On January 15 he had gained only 70 grams in the seven days. As this increase was quite inadequate, I gave him sterilised milk once more, 100 grams per day. In the fourteen days ending January 29 he rose to 5390 grams. He had increased by 440 grams, so his daily average had been 31 grams. I then gave only 50 grams of sterilised milk, but at the end of seven days, finding he had scarcely increased, I again allowed him 100 grams per day. In the next fortnight, his

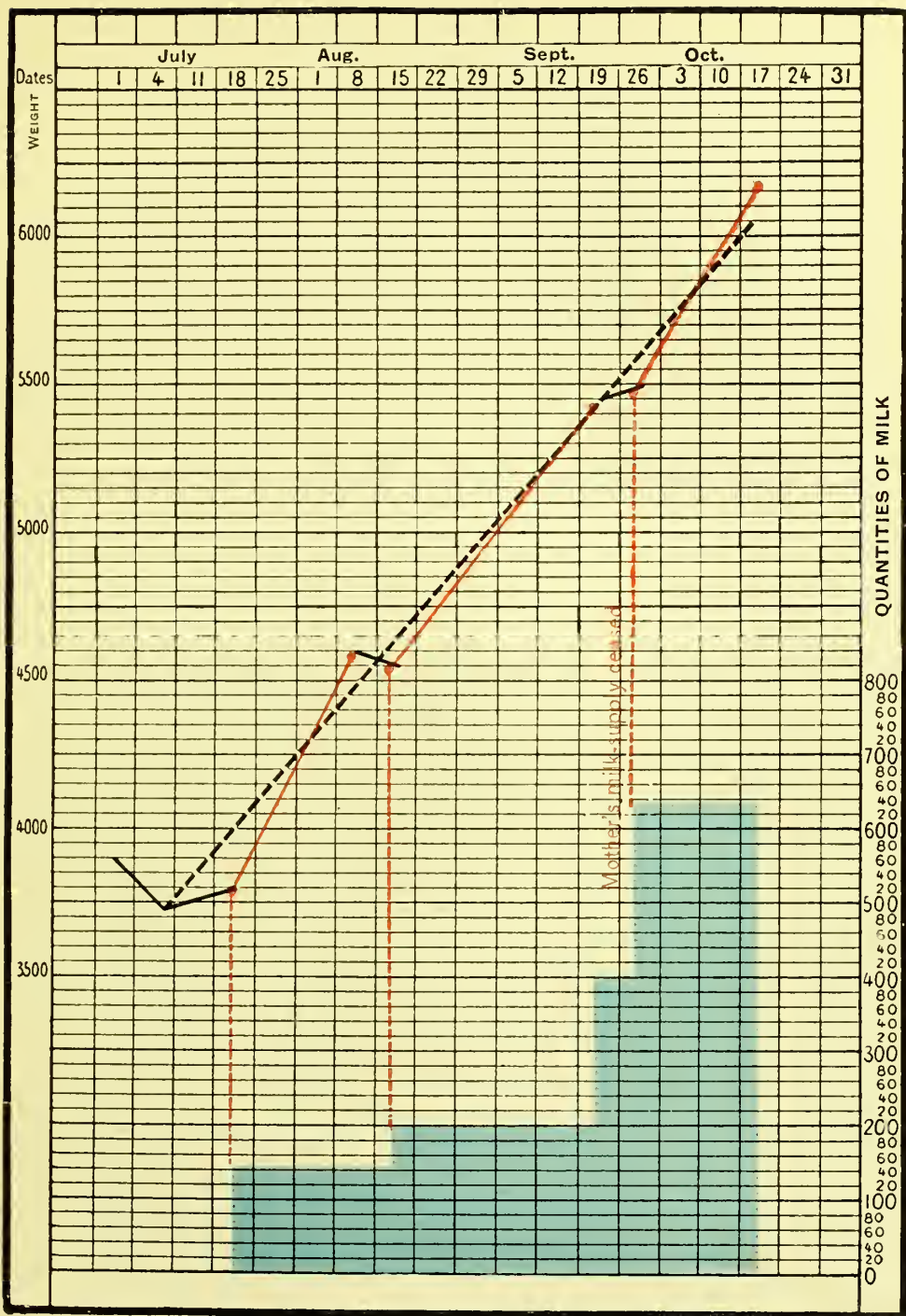


FIG. 90.—Curve showing how mixed feeding may lead to artificial feeding (see p. 117).







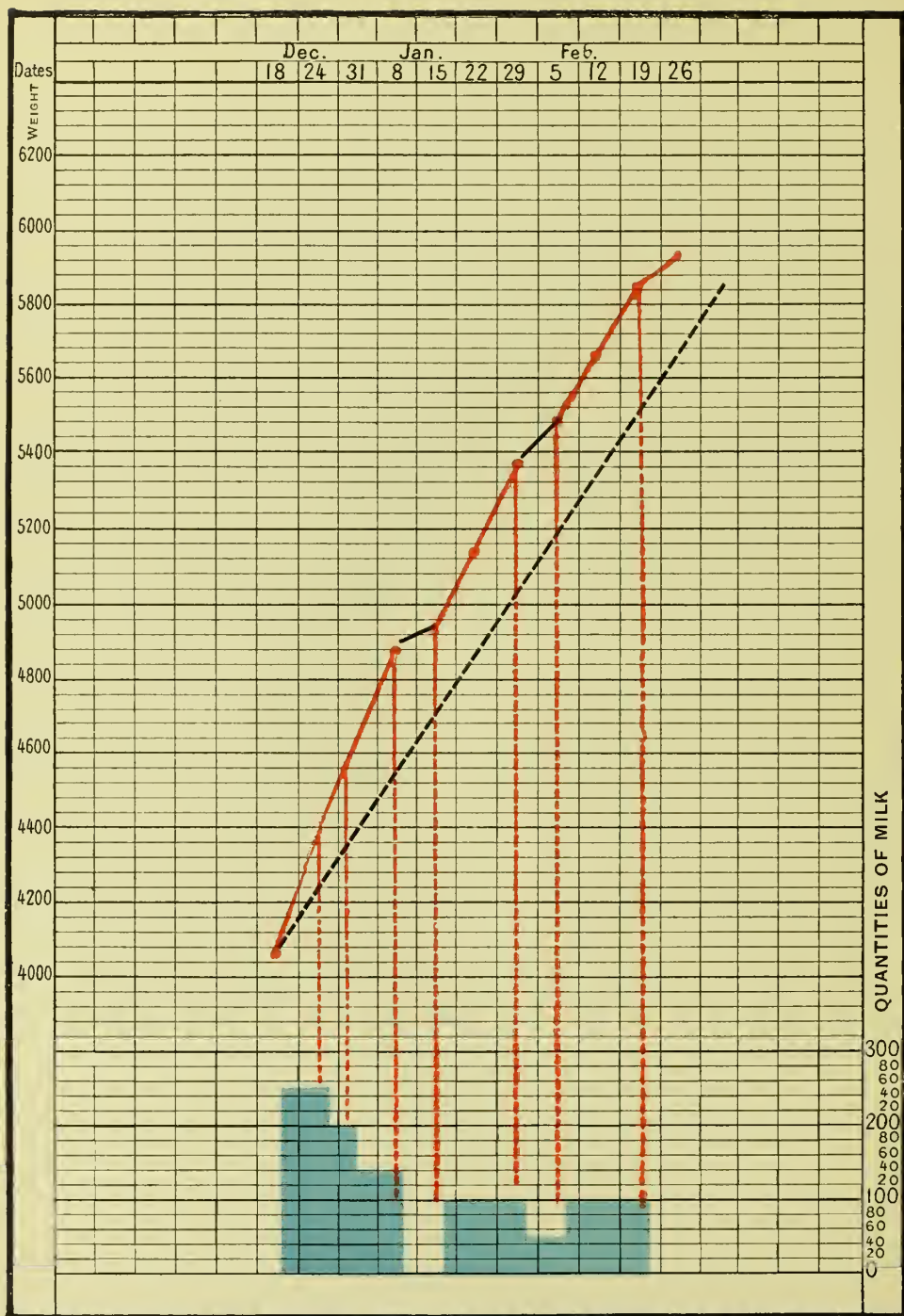


FIG. 91.—Mother had not enough milk. Child placed upon mixed feeding. The mammary secretion became more abundant till the child was exclusively breast-fed.

weight having increased by 360 grams, I made a second attempt to do away with the sterilised milk. The mother responded admirably to the increased demand, and continued the feeding unaided for a considerable period.

By means of the balance every variation in the infant's weight can be followed. It is thus easy to determine the quantity of sterilised milk required in mixed feeding to provide an adequate diet. This amount does not remain fixed. It alters with the infant's needs. Sometimes you may have to increase the sterilised milk till the feeding becomes wholly artificial ; sometimes, under happier auspices, you can gradually diminish it till the child becomes exclusively breast-fed.

## LECTURE VIII

SUMMARY :—Mixed feeding—Its great value where the maternal supply is inadequate—A substitute for a wet-nurse—Its use in twin cases—Mixed feeding enables one woman to rear several infants.

Artificial feeding—Its use in cases of congenital malformation in infant or mother—Artificial feeding in syphilis.

Asses' milk of little nutritive value.

Cows' milk—Sterilisation increases its digestibility.

Sterilised milk administered undiluted to healthy infants—Illustrative cases—Reservations—Opinions of other medical men.

GENTLEMEN,

We had discussed the qualities and sterilisation of cows' milk, and the value of observation and weighing in the regulation of an infant's diet, and I was demonstrating to you that the balance was indispensable as a guide in mixed feeding. I now wish to cite a few more cases which emphasise this important point.

A woman named Lud—— was delivered in the Maternité on March 15, 1896. She was in feeble health, and during a previous lactation I had had considerable anxiety on her account. She was very eager to suckle, and, although she had not much milk, I allowed her to do so. The infant weighed 3050 grams at birth. As on March 28 he was only 2950 grams, I added 200 grams of sterilised milk to his daily ration (Fig. 92). On April 11 he reached 3420 grams, but, owing to the strain on the mother, I increased his cows' milk to 250 grams. His curve soon regained the normal. On May 31 his allowance was raised to 375 grams. On July 25 I learned from the mother that during the last few days her milk supply had greatly diminished. The hungry child had cried incessantly, and she, not wishing to inconvenience me by coming on any but the day set apart for the Consultation, had given the child some milk, previously boiled, in addition to what I had prescribed. I raised the 375 grams to 600, and the curve continued to rise steadily till November 21, when the infant was found to have lost 160 grams within a fortnight. As, in the absence of all pathological phenomena, this loss could arise only from under-feeding, his allowance was increased to 700 grams, and, on this not proving quite sufficient, to 800 grams, from November 28. By



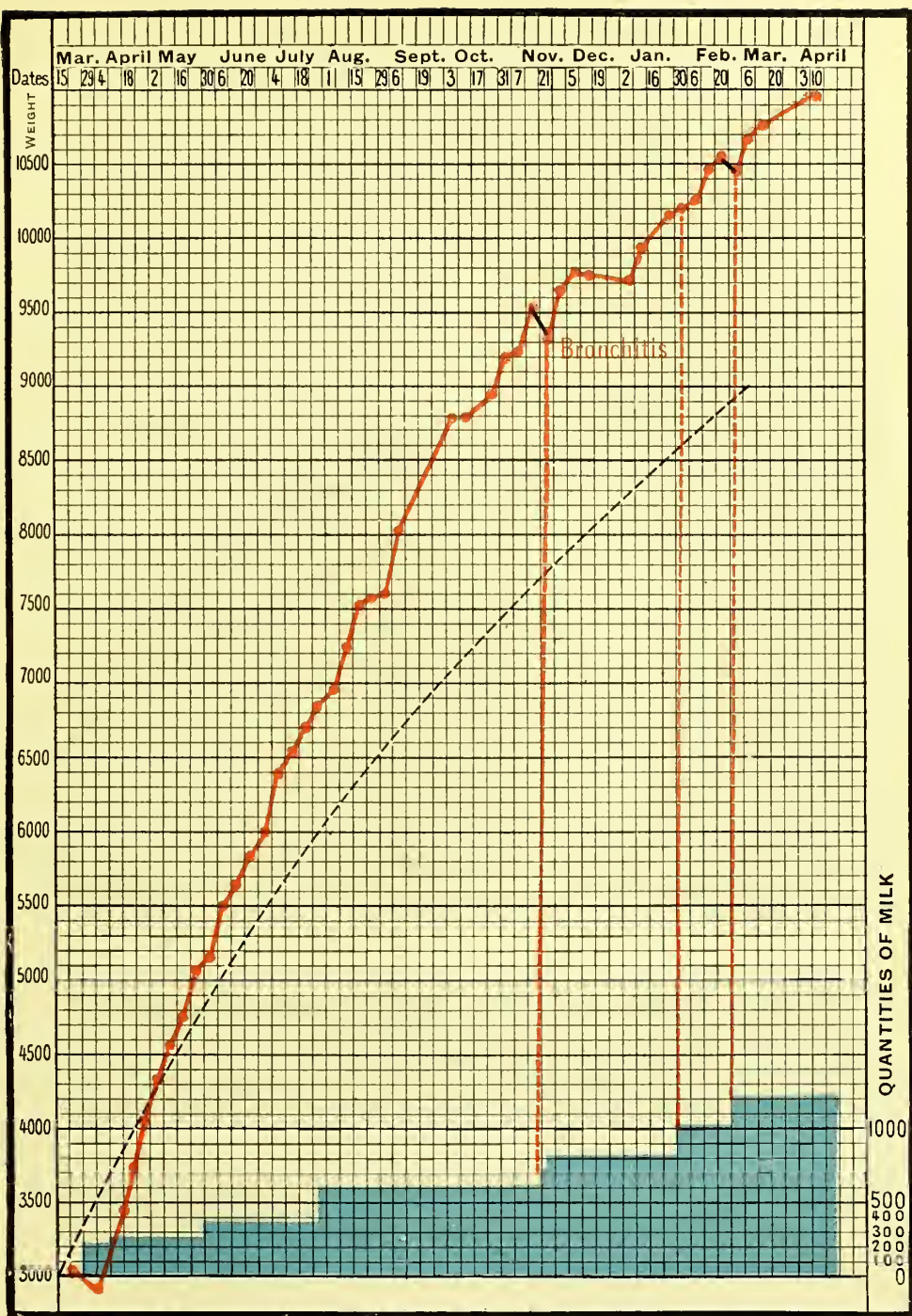


FIG. 92. —Curve of an infant reared on mixed feeding.





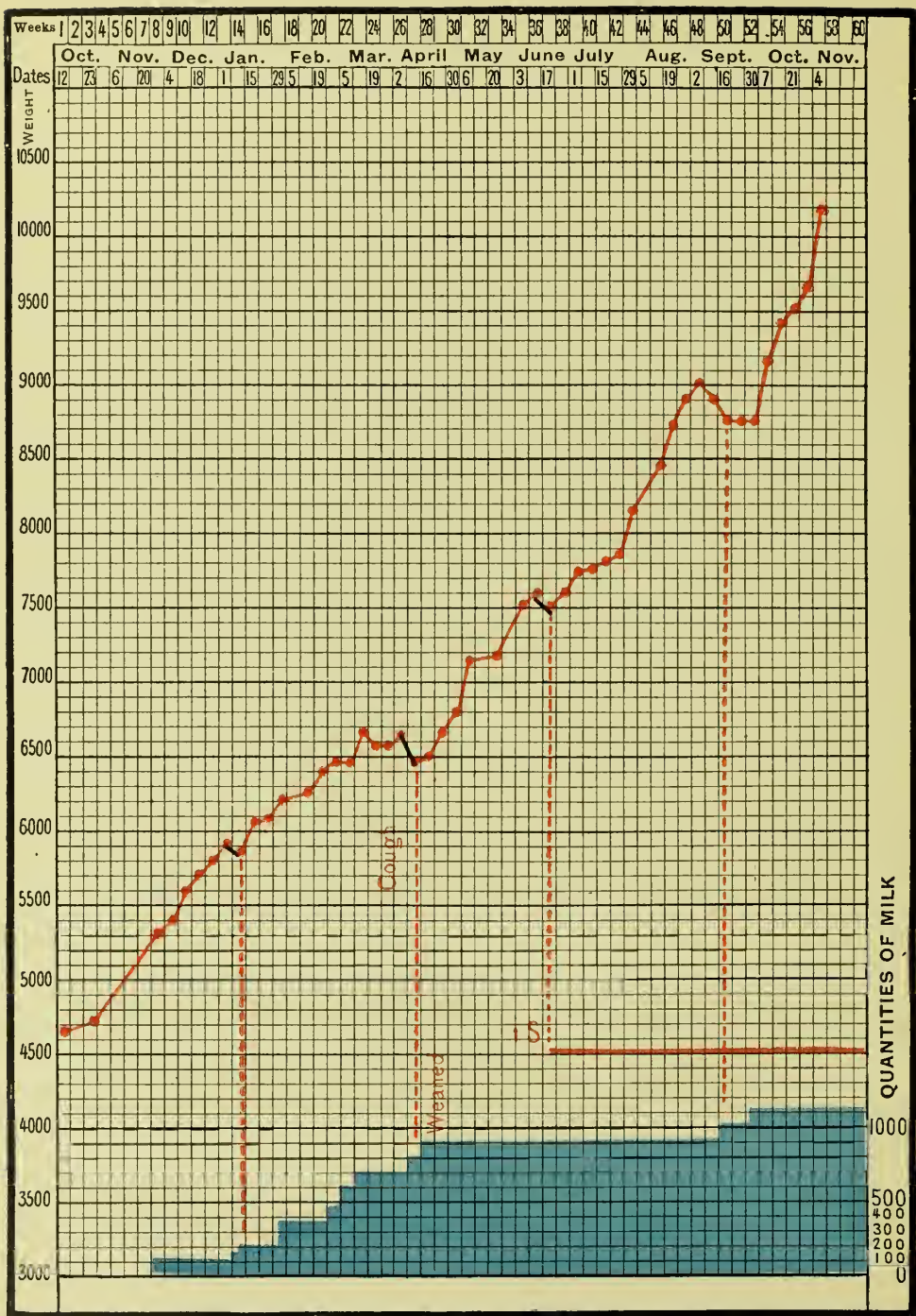


FIG. 93.—Mother had not enough milk. Child reared on mixed feeding.

January 30, 1897, the mother's milk had practically disappeared. The infant weighed 10,200 grams, and was getting 1000 grams of milk per day. This amount had to be increased on February 27 to 1200 grams, but on the whole his curve is excellent, and, indeed, quite above the average.

A woman named Men——, after the usual ten days' stay, left the hospital on October 22, 1897, when her infant weighed 4700 grams; as on her first appearance at the Consultation on November 27 he was only 5320 grams, the average gain per day had not exceeded 19 grams. She told me that, not having enough milk for the child, she had been giving him cows' milk in addition to the breast-feeds. I prescribed 100 grams of sterilised milk, and the infant increased steadily (Fig. 93). On January 8 the menses reappeared, and the child lost weight slightly. I gave 150 grams per day, and on the 12th raised this amount to 200. Again I had to augment the supply; on February 1 I made it 375 grams, but this did not long remain sufficient. On February 26, 450 grams were required; on November 5, 600; and on March 8, 700. On April 9, 1898, the mother's supply having finally ceased, the nursling was given a daily allowance of 800 grams, which, on April 16, was raised to 900. A little farinaceous food was added on June 10. On September 2 he weighed 8950 grams; as on the 9th and 16th he had lost 60 and 170 grams respectively, I increased his sterilised milk to 1000 grams. Immediately he began to gain, and on November 4, although barely thirteen months old, scaled 10,120 grams. A subsequent lactation in this woman followed the same course.

Every Wednesday a woman brings her little grandson, Su——, to the Consultation. He was born here on September 10, 1898. Breast-fed by his mother, he weighed 4500 grams on September 30, having gained 600 grams since birth. The mother, being unmarried and poor, had to work to live. The grandmother brought the child to me on October 7, and begged a little sterilised milk. I refused, for I make it a rule to insist, whenever possible, on breast-feeding, and, moreover, I object to children being brought to the Consultation by any but their mothers. "But," pleaded the grandmother, "we must live, so my daughter must work. Her employer allows her to leave the factory only at meal-times. She suckles her child then. What would you have us do? We are too poor to give the little one a nurse." "If I give you cows' milk," I said, "how long will your daughter be able to suckle? Her milk will soon disappear, and the child will be exposed to all the risks of



artificial feeding." "I assure you," replied the old woman, "that my daughter will give the child every drop of milk she can produce. If you do not grant me the milk we shall have to buy it, and not only will this be a great burden to us, but, further, any milk we can obtain will probably be inferior to that which you distribute. Give me the milk, sir, and you will see how well the little one will be cared for." Needless to say, gentlemen, I gave way. On October 7 I gave 200 grams of sterilised milk per day; on the 28th, 250; on November 18, 300; on November 25, 350; on December 9, 400; on February 3, 450; and on April 28, the mother's supply having altogether ceased, 675 grams. On May 12 the infant weighed 7210 grams. We had ended, as I had feared, with artificial feeding, but the infant had reached seven months, and was of more than average weight for his age (Fig. 94).

Mothers who live in the whirl of modern society life, eager though they may be to suckle their children, are often incapable of nursing, because they produce but little milk. A wet-nurse was formerly their only resource, but, nowadays, sterilised milk may be used to make good their deficiency. I could cite to you many cases in which I have used it to supplement the scanty supply of such mothers. They are very grateful for its help, since it not only spares them the worry of a wet-nurse—in itself a no uncertain blessing—but also the mortification of having their children suckled by a stranger.

There are other ladies again who, in spite of their desire to nurse, feel that they have obligations beyond their domestic circle which they are in duty bound to fulfil. They replace their breast-feeds, during that portion of the day when they go to pay their social tax, by one or more bottles of sterilised milk. Such mothers are often excellent nurses; their children thrive, and, when the time comes for weaning, this mode of feeding is found greatly to simplify the process.

Mixed feeding is an inestimable boon to mothers of twins, for they can rarely provide enough to satisfy the needs of both. Let me give you two out of my many cases.

A frail and miserable-looking woman, named G—, was delivered of twins, a boy and a girl, on January 27, 1893. The boy weighed 3800 and the girl 3420 grams, when they left hospital (Fig. 95). The mother was then receiving 300 grams of sterilised milk with which to complete their feeding. This amount had to be increased from time to time—on February 10 to 400 grams, March 10

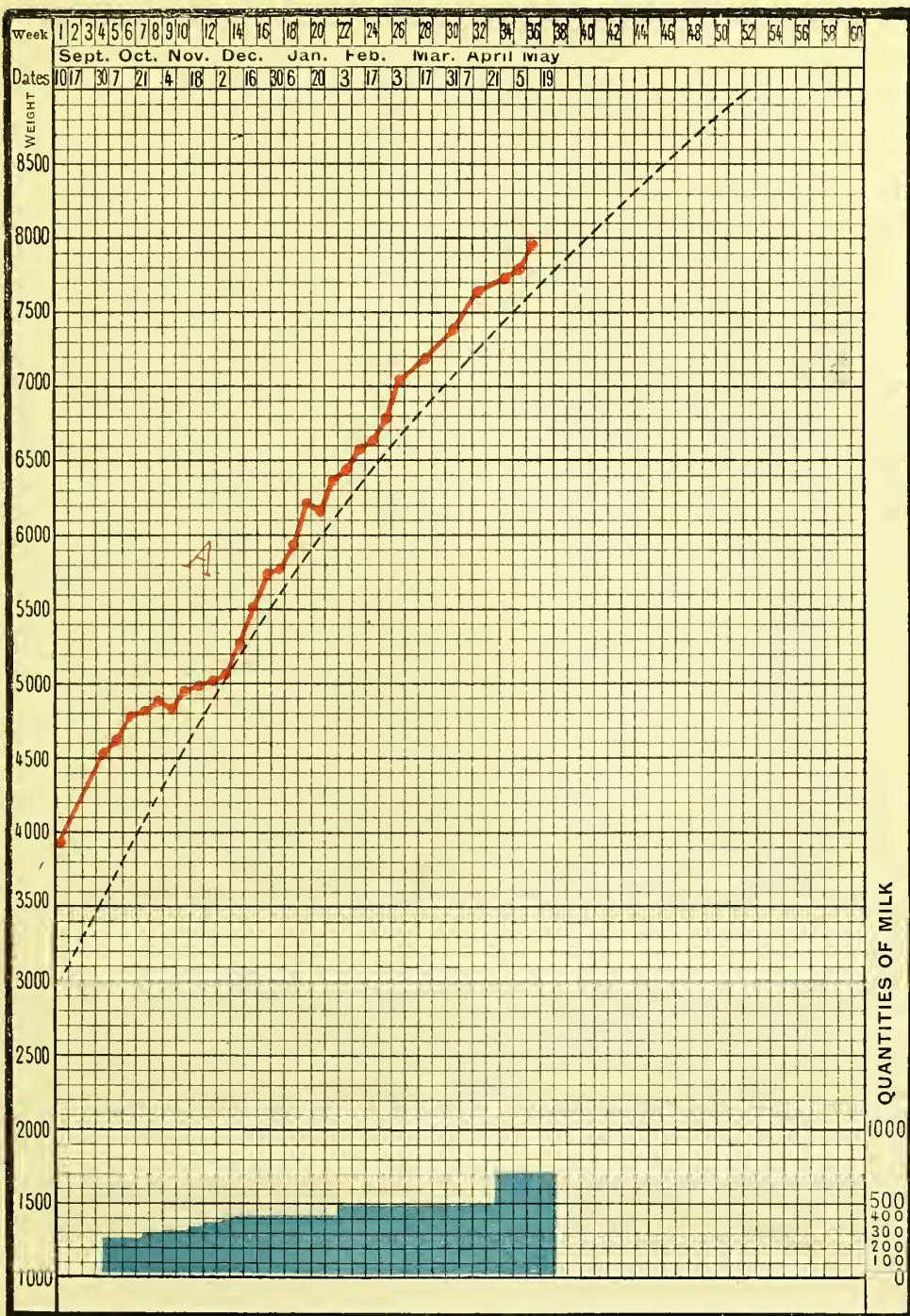


FIG. 94.—Curve of an infant at first breast-fed by its mother, who had plenty of milk. As she had to go out to work, mixed feeding was practised.





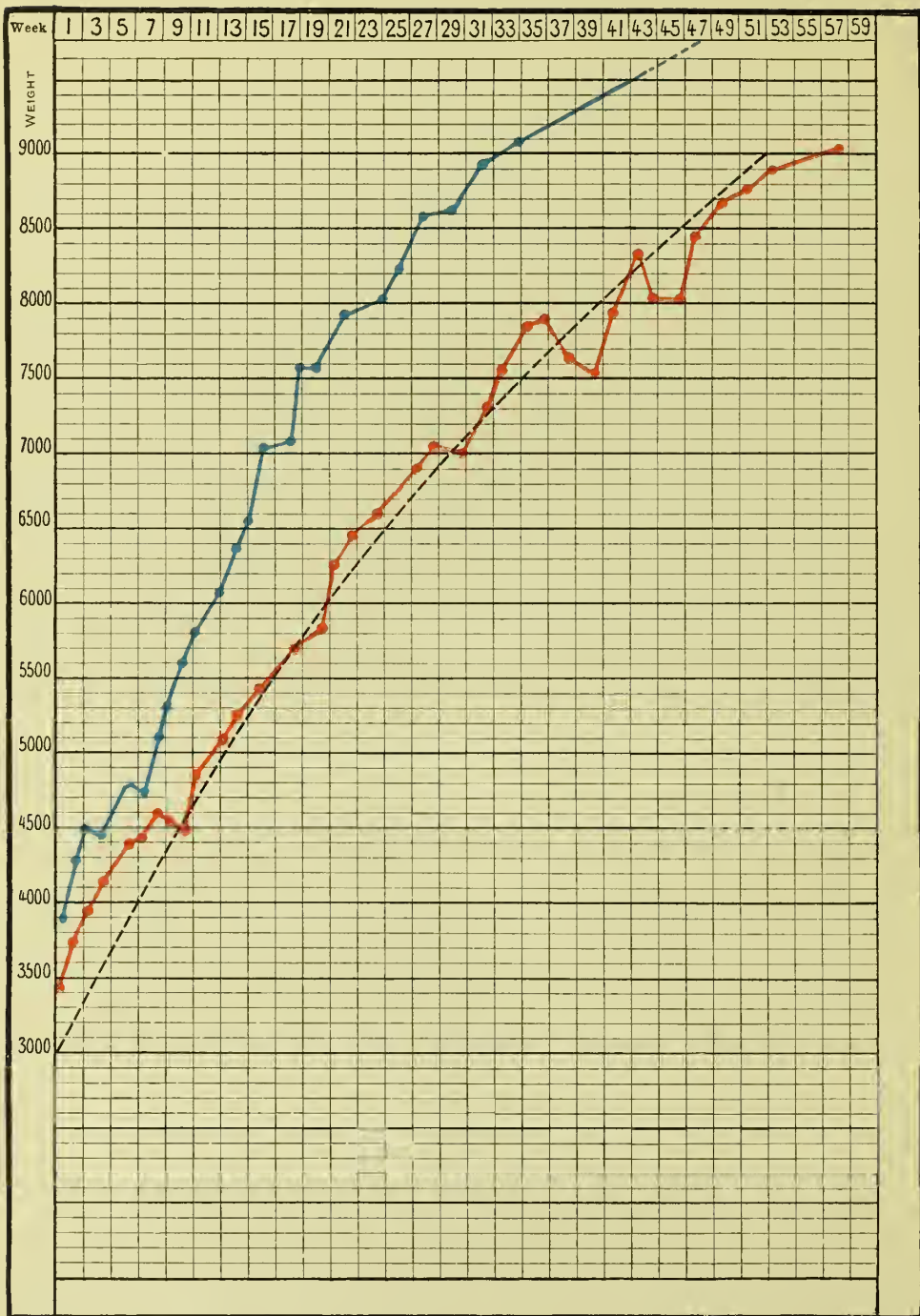


FIG. 95.—Twins (blue, boy; red, girl) reared on mixed feeding, as the mother had not enough milk adequately to nourish both.



to 600, and March 31 to 1200. The mother's milk having ceased on June 30, the feeding became entirely artificial. Although they lived in a small, squalid, overcrowded room, the infants continued to thrive. Their progress was arrested for a time by an attack of bronchitis at the end of December, but on March 9 the boy weighed 9940 and the girl 9040 grams.

A son and a daughter were born to a woman named L—, on December 10, 1892. When they left hospital on December 22, the girl weighed 3080 and the boy 2900 grams (Fig. 96). They were brought to the Consultation on December 30, weighing 3380 and 3090 grams respectively. As they lived far from the hospital, I gave the mother a steriliser, so that she might prepare the children's milk at home. The mother lavished great care on them, and they thrived. But on July 1, 1893, having some business to do, she entrusted them for the day to a friendly neighbour; on the next day both had diarrhoea, and in less than twenty-four hours the girl lost 600 and the boy 370 grams. Happily they quickly recovered, and on January 5, 1894, weighed 9800 and 9300 grams respectively.

I shall not repeat what I have already told you relative to the rearing of the children of the wet-nurses at the Maternité. Here, at the Clinique Tarnier and in many similar institutions, the same plan is successfully followed.<sup>1</sup>

In our statute books there is an excellent measure for the protection of infant life, known as "Roussel's Law." Among many admirable clauses there is one which prohibits mothers from suckling any but their own infant till it shall have completed the age of seven months. There are many more mothers than good nurses, and it seems to me that by this clause an undesirable restriction is placed upon breast-feeding. In one case which came under my notice a wet-nurse was threatened with legal proceedings for suckling a nursling when her own child was not seven months old. The nursling was then returned to its parents, and they, despairing of finding a wet-nurse whose milk was not what they called "too old," fed it on the bottle, and it died of diarrhoea.

I think that a woman who has suckled her child for several months might, if authorised by her medical attendant, introduce in gradually increasing quantities sterilised milk into its diet. She could thus divert, without prejudice to her offspring, a portion of

<sup>1</sup> Millet, *L'Obstétrique*, 1897, p. 51; Charpentier, *La Revue Philanthropique*, Nov. 1898, p. 5.

her milk to another nursing, and the two, carefully supervised, would steadily thrive. Perhaps, after a few months, even a third might be added. The first nursing, like the wet-nurse's own child, could be put on mixed feeding, and the new-comer given the breast exclusively.

A good wet-nurse, under medical supervision, might thus steer several children through the dangers of early infancy and launch them in safety upon mixed and artificial feeding. By this means the scarcity of good wet-nurses could be counterbalanced, and full advantage taken of the few at our disposal.

Artificial feeding, the rearing of a child exclusively on animal milk, is sometimes, unfortunately, a necessity from birth, for some infants have congenital deformities which prevent suckling (see p. 102); others persistently refuse to take the breast (see p. 103); and others again seem to be unable to digest human milk (see p. 104). It may be that the mother cannot suckle; in some, the nipples are represented only by depressions on the summits of the mammary glands; in others, ill-health contra-indicates nursing; while others, attacked by acute infectious diseases, are forced to wean. The choice then lies between a wet-nurse and artificial feeding. The results obtained from careful artificial feeding are excellent, and many practitioners prefer it to confiding the child to a stranger, or introducing an element of potential disturbance into a peaceful household.

In July 1892 a country doctor, one of my old pupils, called me to see his wife, who, he thought, was about to develop puerperal fever. On my arrival I was happily able to reassure him, for the alarming rise of temperature was due to a simple mastitis. The mother, however, had absolutely no milk, so attempts were made to procure a wet-nurse, and I advised, in the meantime, the use of sterilised milk. The country was scoured in a vain search for a wet-nurse, till the parents, reconciling themselves to the inevitable, settled down to rear the child on animal milk. At birth the child weighed 3000 grams. On November 23, at the age of five months, she was 8250 grams (Fig. 97), and the proud father wrote to me that she was without exception the strongest and healthiest child he had ever seen, and that he felt absolute security in her mode of feeding.

Where one or both parents are syphilitic and the mother has no milk, artificial feeding must be adopted. You have no option. You must not expose a wet-nurse to the risk of suckling in such a case. Let me cite to you two typical instances.

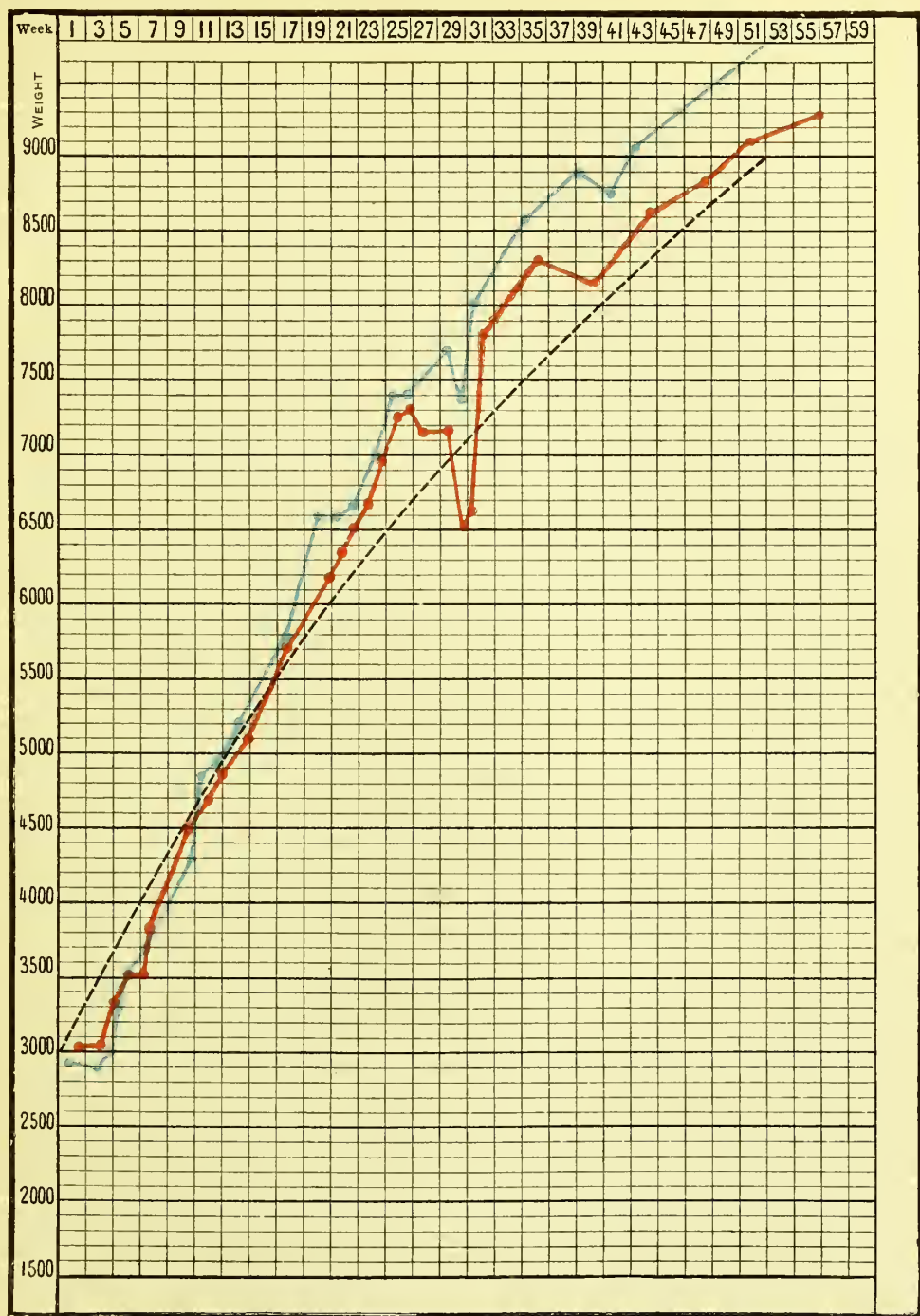


FIG. 96.—Twins. Mixed feeding (blue, boy; red, girl).







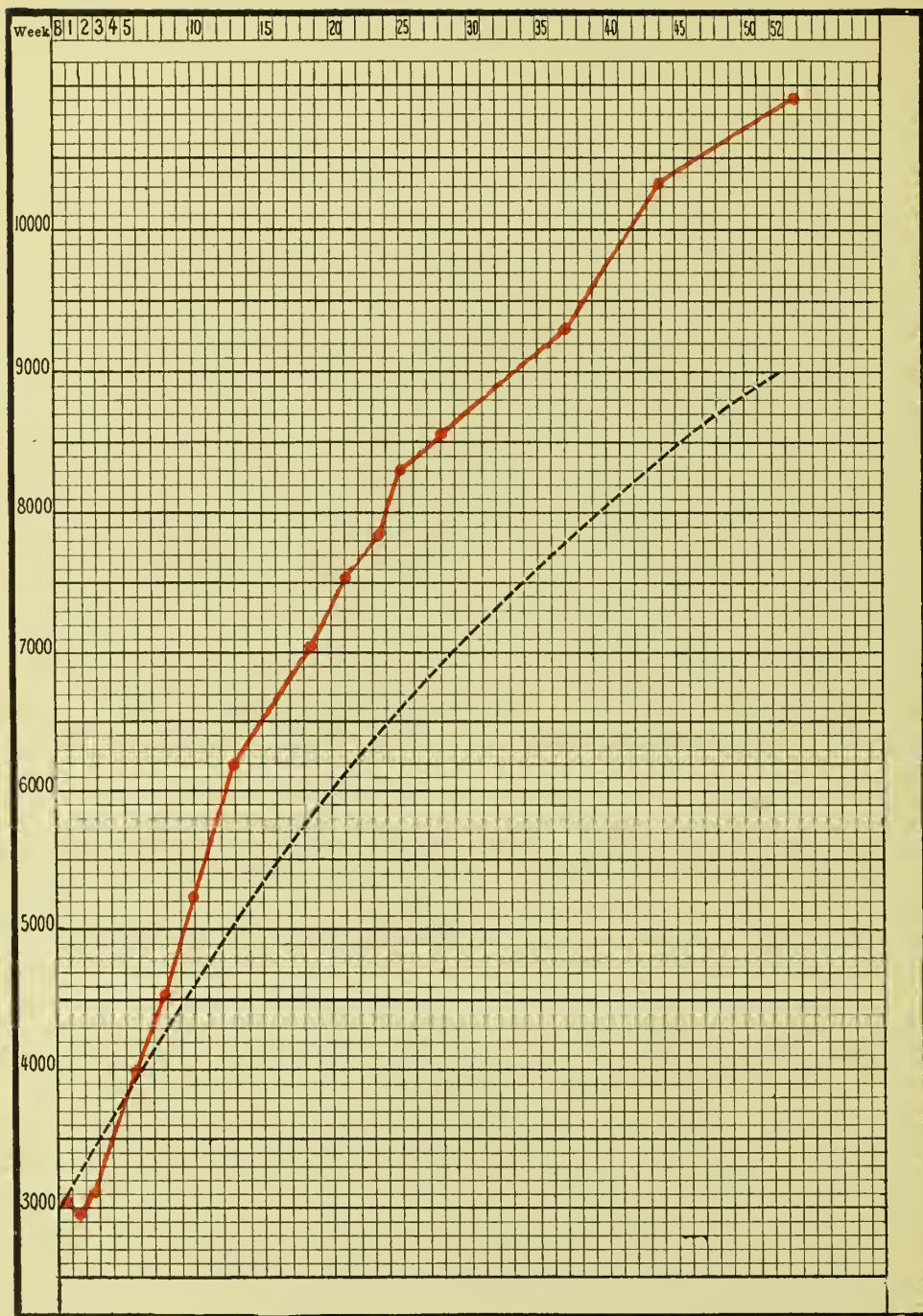


FIG. 97.—Artificial feeding. Mother had no milk, and a wet-nurse could not be obtained.

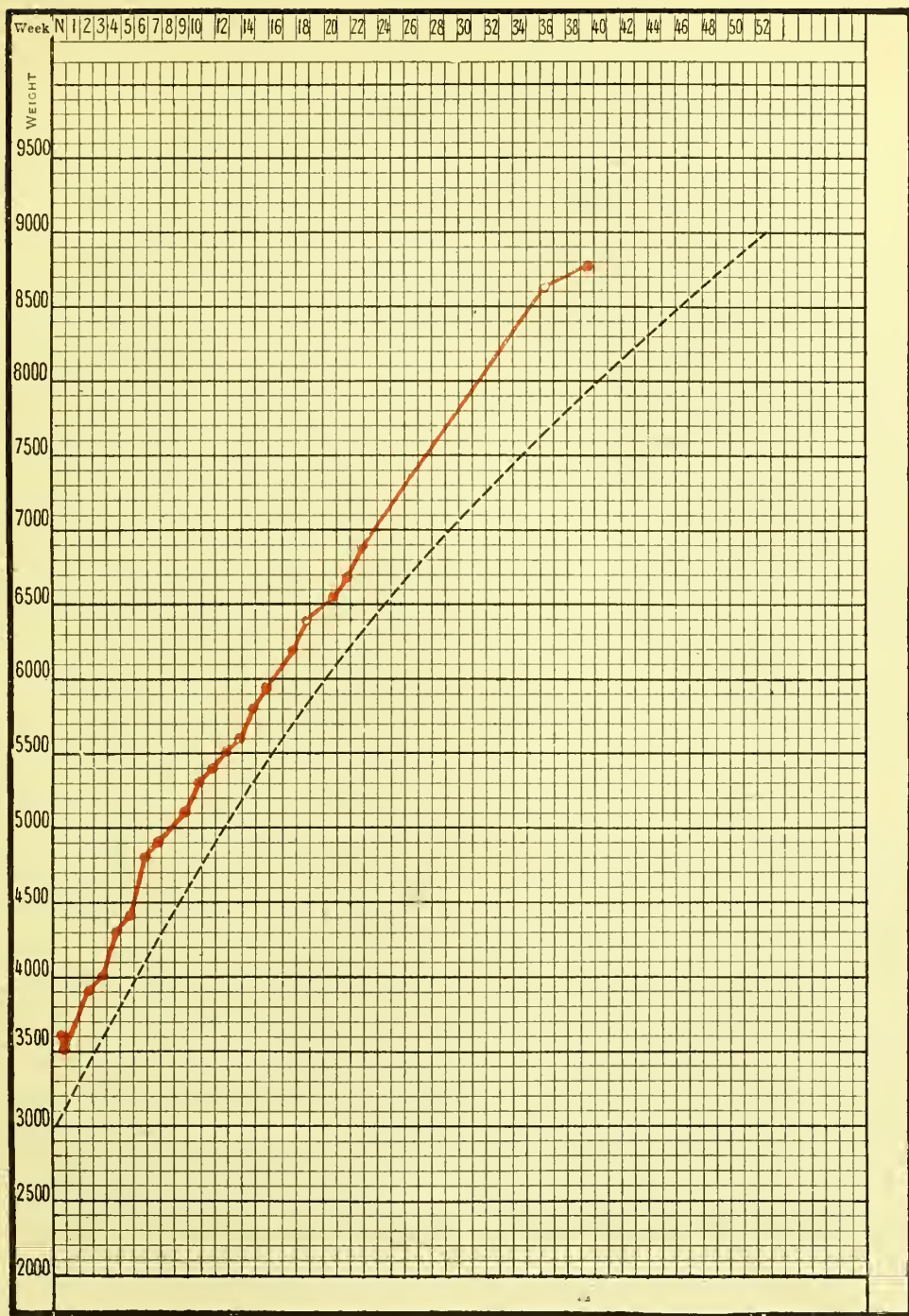


FIG. 98.—Congenital syphilis. Mother had no milk. Artificial feeding.





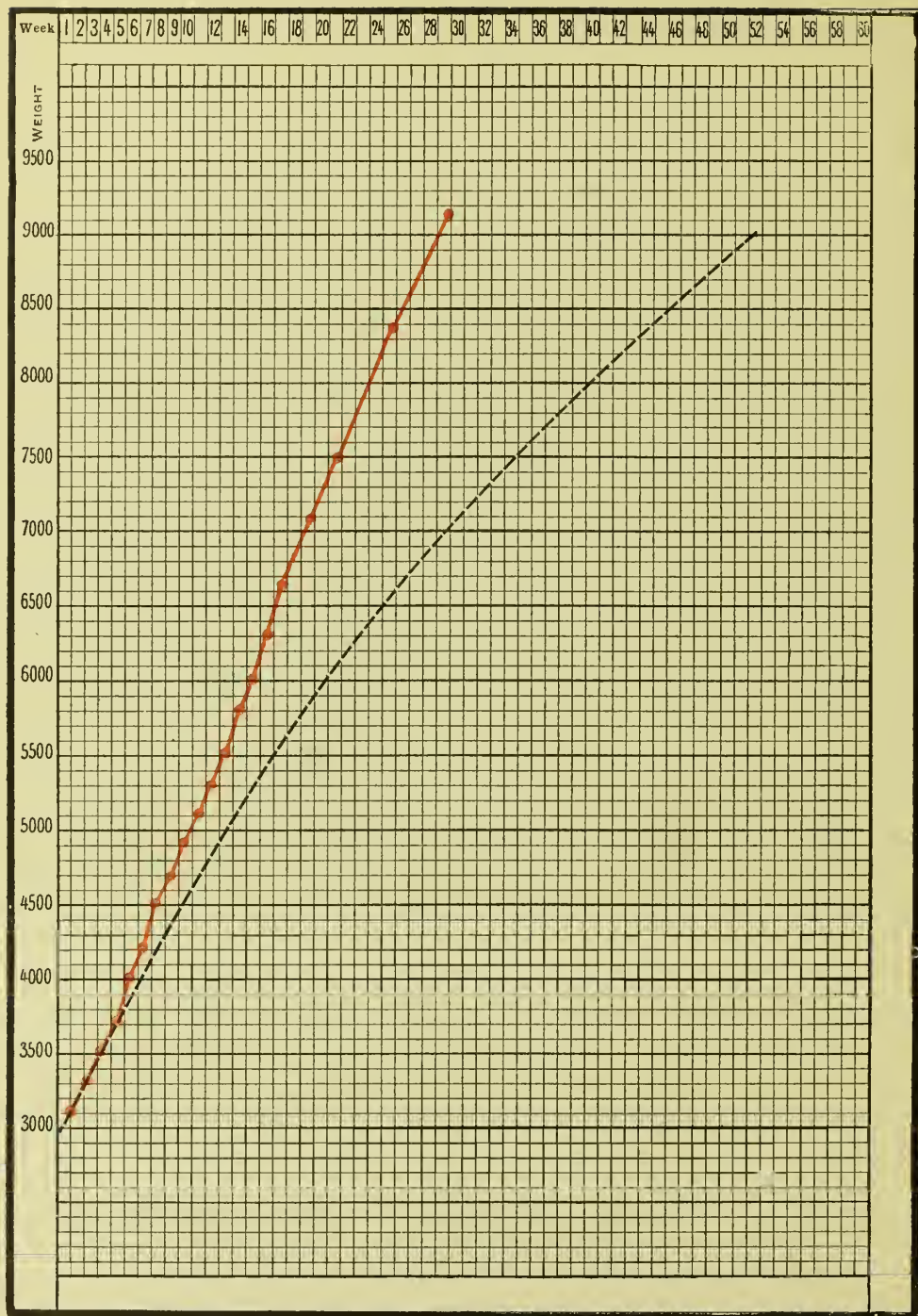


FIG. 99.—Syphilis in the parents. Mother had not enough milk. Artificial feeding.



After several pregnancies productive of dead foetuses Dr. X—— and his wife were suspected of syphilis and treated accordingly. A living daughter was born to them in September 1892. She weighed 3550 grams, and during the first fortnight gained on an average 26 grams per day. An ulcerative eruption appeared on the child in the third week, but it was not a typical syphilide. The mother had practically no milk, but, in spite of the father's entreaties, I refused to take the responsibility of recommending a wet-nurse; the child was therefore fed on sterilised milk. She made very satisfactory progress, and her curve was above the average. On December 14, 1892, she weighed 5240 grams, and on July 6, 1893, had reached 8780 (Fig. 98).

M—— C—— had syphilis, and his wife aborted several times. He was given mercury. His wife conceived; she was put on anti-syphilitic treatment, and on July 5, 1893, gave birth to a full-term, living, and healthy son weighing 3150 grams. As the mother's supply soon became insufficient for his needs, sterilised milk was prescribed. On August 16 he weighed 4480 grams; on November 15, 7560; and on January 15, when the mother's milk finally disappeared, 9200 grams. He never presented any specific lesion, and his curve was excellent (Fig. 99).

I have had many similar cases, and Professor Fournier, the eminent authority on this subject, has published some interesting observations, in which he also emphasises the inestimable advantage of artificial feeding for these tainted infants.

Should cows' milk be given undiluted? It is generally supposed to be harmful to infants, owing to the excess of casein it contains compared with the human product. To counteract this defect great quantities of water are usually added to the milk. The dilution varies with the age: at first, three parts of water are added to one of milk, then two; then equal parts of each are used, then two of milk and one of water, and so on to the fifth or sixth month, when undiluted milk is reached. But casein is not the sole constituent of milk. It contains also butter, sugar, and salts, all of which materially contribute to its value as a food. Diluted cows' milk is generally deficient in these substances, and therefore forms but a poor substitute for a mother's milk. To obtain sufficient nourishment on this attenuated diet infants are obliged to absorb great quantities of fluid, which causes them to pass a large amount of urine. They are almost always crying from hunger, whereas infants on undiluted milk wait contentedly for their next meal.

An infant, one of twins, was first fed on undiluted sterilised milk; from the second day the increase was on an average 21.6 grams per day (Fig. 100). Then one-third of its bulk of water was added to the milk; during the next five days he gained only 6 grams per day. Once more he was given pure milk, and he increased normally again. The diet of the other twin was varied in the same way with a similar result.

Another infant, who was born on August 22, 1893, weighing 2485 grams, and who was being artificially fed, was brought to me on December 8, 1893, because his rate of growth was very slow. As his weight was 4300 grams, he had increased by only 18 grams per day. He was receiving diluted milk, but on placing him upon pure milk, his daily average increase rose to 30 grams. On February 18 he weighed 6480 grams. The second part of his curve compared with the first affords a striking demonstration of the relative values of pure and of diluted cows' milk as foods for infants (Fig. 101).

One day an engineer entered my consulting room. "I am bringing to you," said he, "my child one month old. He is in the next room with my wife, but I want to tell you beforehand that I have had syphilis, and that my wife, without her knowledge, was treated for that complaint during her pregnancy. Our child was born at full term, but he has had to be fed on cows' milk, as my wife could not suckle and I did not wish to bring in a wet-nurse. He weighed 3000 grams at birth and has not gained since. I am afraid that he also is infected, and I have come to see if you can do anything for him."

I examined the child; he was wizened, wrinkled, and puny, but he showed no trace of specific disease.

"How much milk do you give him?" I asked.

"Half a litre per day."

"Half a litre of undiluted milk?"

"No! he is but newly born. I give him two parts of water and one of milk."

"Come, sir, you are an engineer and accustomed to calculate. Let us reckon this up. The child gets 500 grams of liquid per day. Now, if you are using good milk, each litre will contain 870 parts of water and 130 of solids, consisting roughly of 40 parts of butter, 50 of sugar, and 40 of casein and salts.

"Now, if you add two parts of water to one of milk, a litre of the mixture will contain one-third of the normal amount of solids;  $130 \div 3 = 43.3$  grams.

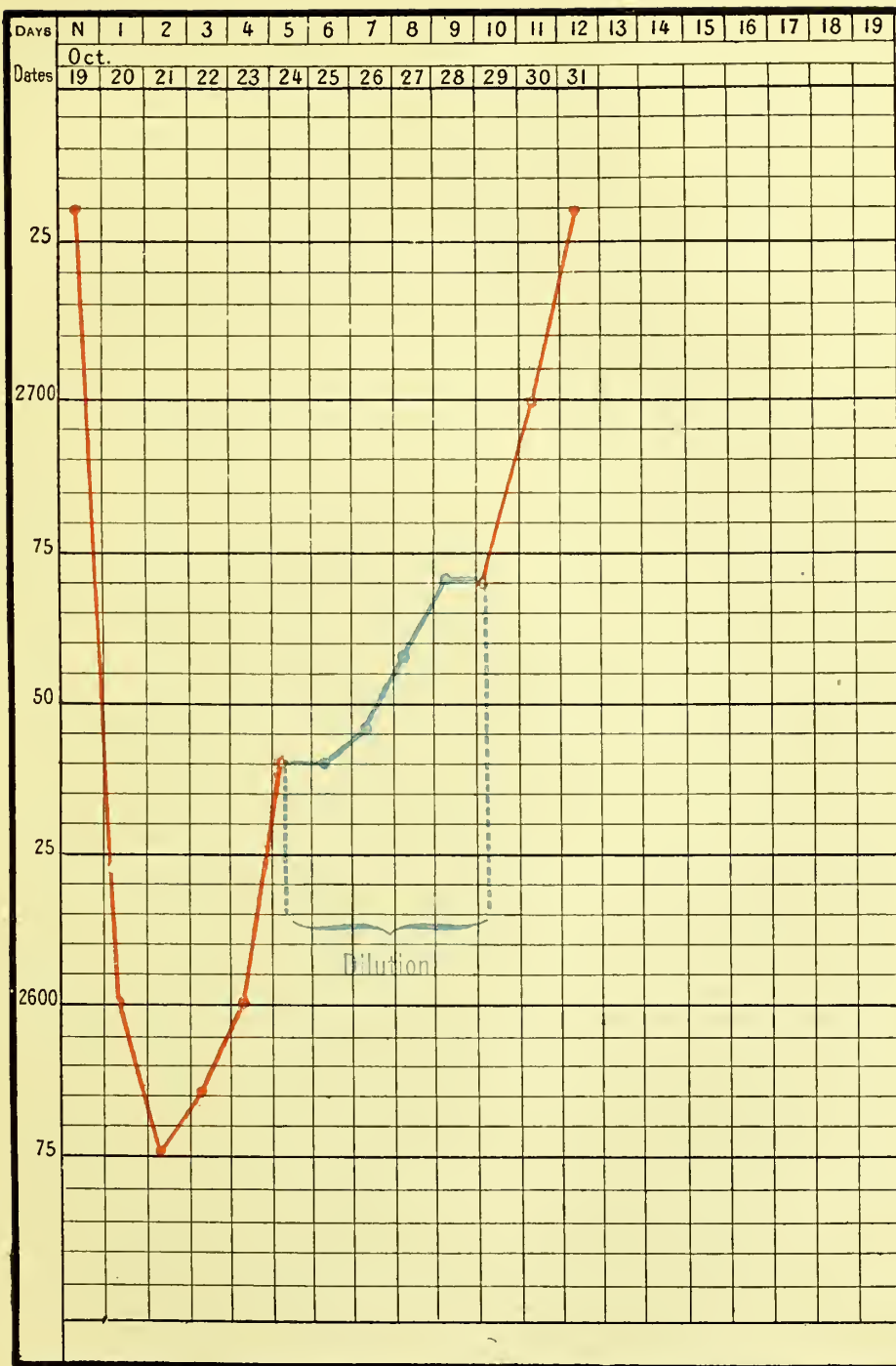


FIG. 100.—Effect on an infant's weight of feeding with diluted milk.







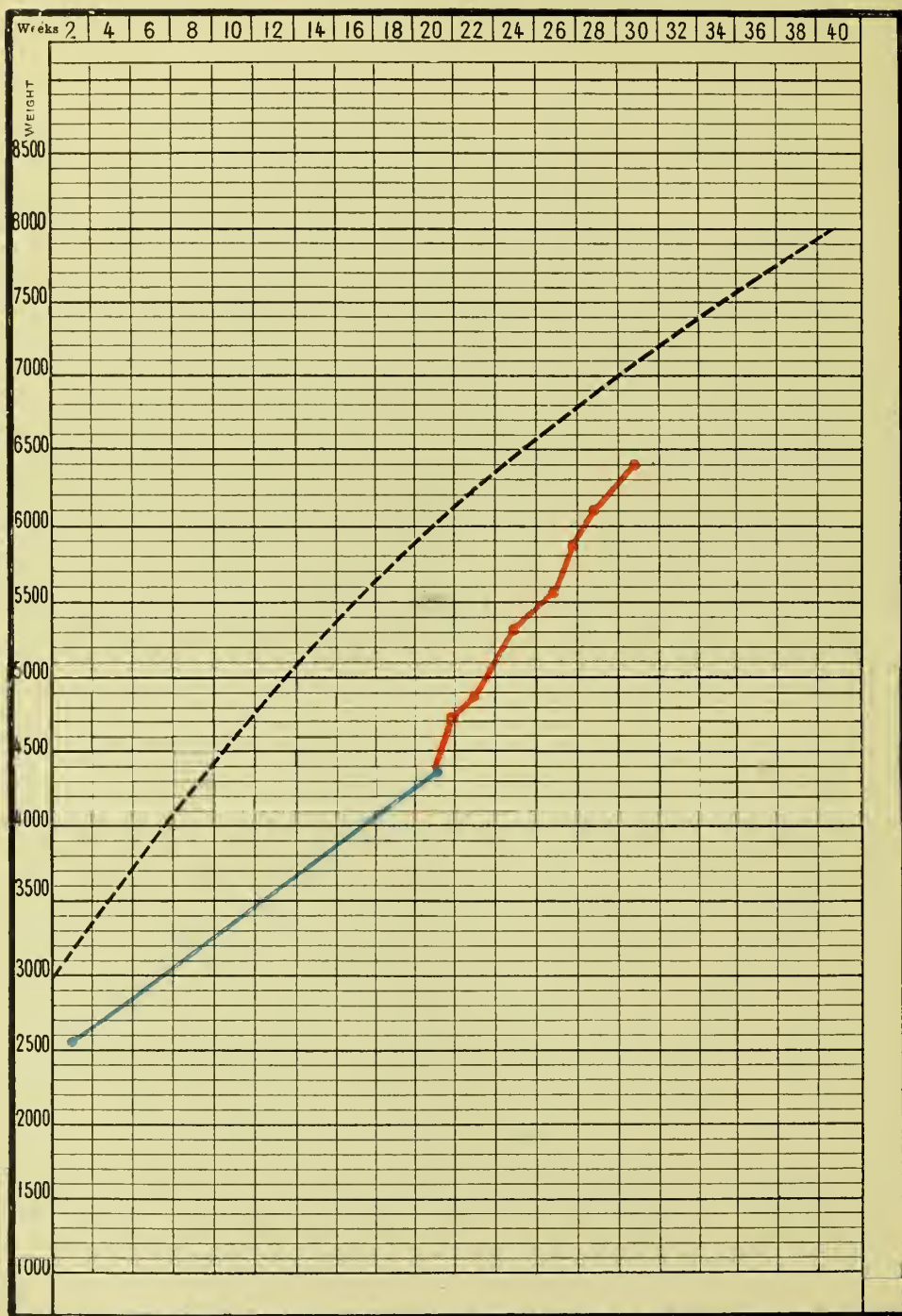


FIG. 101.—Artificial feeding, first with diluted (blue) and then with undiluted milk (red). The blue part of the curve persistently falls away from the normal line which the red part rapidly approaches.

"Your infant takes only half a litre of this mixture, so it gets half of 43.3 grams, *i.e.* 21.65 grams of nutritive matter per day. The child is suffering from starvation."

Thenceforth the infant received 500 grams of pure sterilised milk. At the end of one week he had gained 200 grams, and he continued to thrive to his parents' entire satisfaction.

Obviously, when an infant takes animal milk of poor quality it has to absorb large quantities. Some specimens of asses' milk sold in Paris contain very little nourishment. On November 7, 1899, I attended at the birth of a child, Jean X——, who weighed 3120 grams. As he had a hare lip he could not suck, and was fed artificially. I began by giving him asses' milk. Although he took 450, 500, 600, 650, and then 735 grams per day, his curve did not rise as well as I desired (Fig. 102). Twice I analysed this milk; the first time I found 9 and the second 11 grams of butter per litre. From November 20 I substituted 50 grams of cows' milk at one feed each day. On the tracing the asses' milk is represented in blue, the cows' milk in red. Observe how the blue column descends from day to day while the red rises. By November 28, cows' milk alone was being given, and the curve continued to rise steadily, although only 450 grams were being ingested instead of 735. The bulk of the infant's diet had thus been reduced by 285 grams, and yet he was not underfed, as the cows' milk contained 40 grams of butter per litre, whereas the asses' milk had only 9 to 11 grams.

It is alleged that the casein of cows' milk forms large clots in the stomach and gives rise to digestive troubles. This is obviated if the milk be heated in a steriliser at a temperature of about 100° C. "According to my experiments *in vitro*," says Chavane,<sup>1</sup> "the clot of milk thus sterilised offers no resistance or sense of elasticity to the finger, on pressure; it yields like a thick fluid, such as cream, and on microscopical examination, although the fat globules are not appreciably altered, the particles of casein are found to be smaller and more homogeneous. It differs from the fine clot of human milk; it is distinct from that obtained from asses' milk, but it is quite comparable with the latter as regards the size of the casein particles. Obviously, this sterilisation below boiling-point, heating to 100° C., modifies the casein so as to affect the state of subdivision of the clot, and also the molecular structure of the

<sup>1</sup> *Du Lait Sterilisé*, Paris, 1893.

particles. This, probably, explains why milk thus sterilised is more easy to digest than either fresh or boiled milk.

Sterilisation is greatly simplified by the use of undiluted milk. It is a complicated process when dilution has first to be performed according to the infant's age. When the same milk is dispensed to infants of all ages the mother's duties are made easy, and the work of Consultations and *crèches* is greatly facilitated.

When I first advocated the feeding of infants on undiluted milk, critics asserted that infants could neither support nor digest it, and that it was responsible for quite a catalogue of evils—digestive troubles, rickets, eczema, urticaria, &c. I have never seen any bad results from its use, and infants, thriving on it, may be seen daily at the Consultation. The milk I distribute contains 37.35 grams of butter, on an average, per litre, and I have obtained excellent results from it. In 1894 I stated my position on this matter as follows: "I carefully refrain from asserting that during the first months of life milk ought invariably to be prescribed unmixed with water. Just as infants may not be able to support their mother's milk if it is too rich, so they may not tolerate some specimens of cows' milk overcharged with butter or casein. Cows' milk is not of constant composition: it varies with the breed of the animal, the feeding, and other factors. Again, infants may or may not be healthy, and in the latter case their digestive tube has need of judicious treatment. Thus, each infant must be dieted according to the existing conditions, and it may be of service to add a variable quantity of ordinary water, barley water, lime water, or other diluent to its milk. My custom is to prescribe pure milk, and any departure from this is determined upon only after careful observation."

As regards artificial feeding from birth, my experience is yet too limited to warrant any dogmatic statement of the most advisable method during the first few weeks of life. As I always endeavour to insist on breast-feeding, my cases are not numerous enough to base any definite opinion upon. Probably, in those infants who do not tolerate pure milk at the beginning some form of digested milk, such as that which I used for the weaklings (p. 46), might be found of service.

I warned you against overfeeding breast-fed babies. The same precautions must be taken when they are fed on sterilised milk, in order to avoid digestive troubles.

An infant I was treating at the Charité was taking 700 grams of milk and increasing in weight at a remarkable rate. On the twenty-



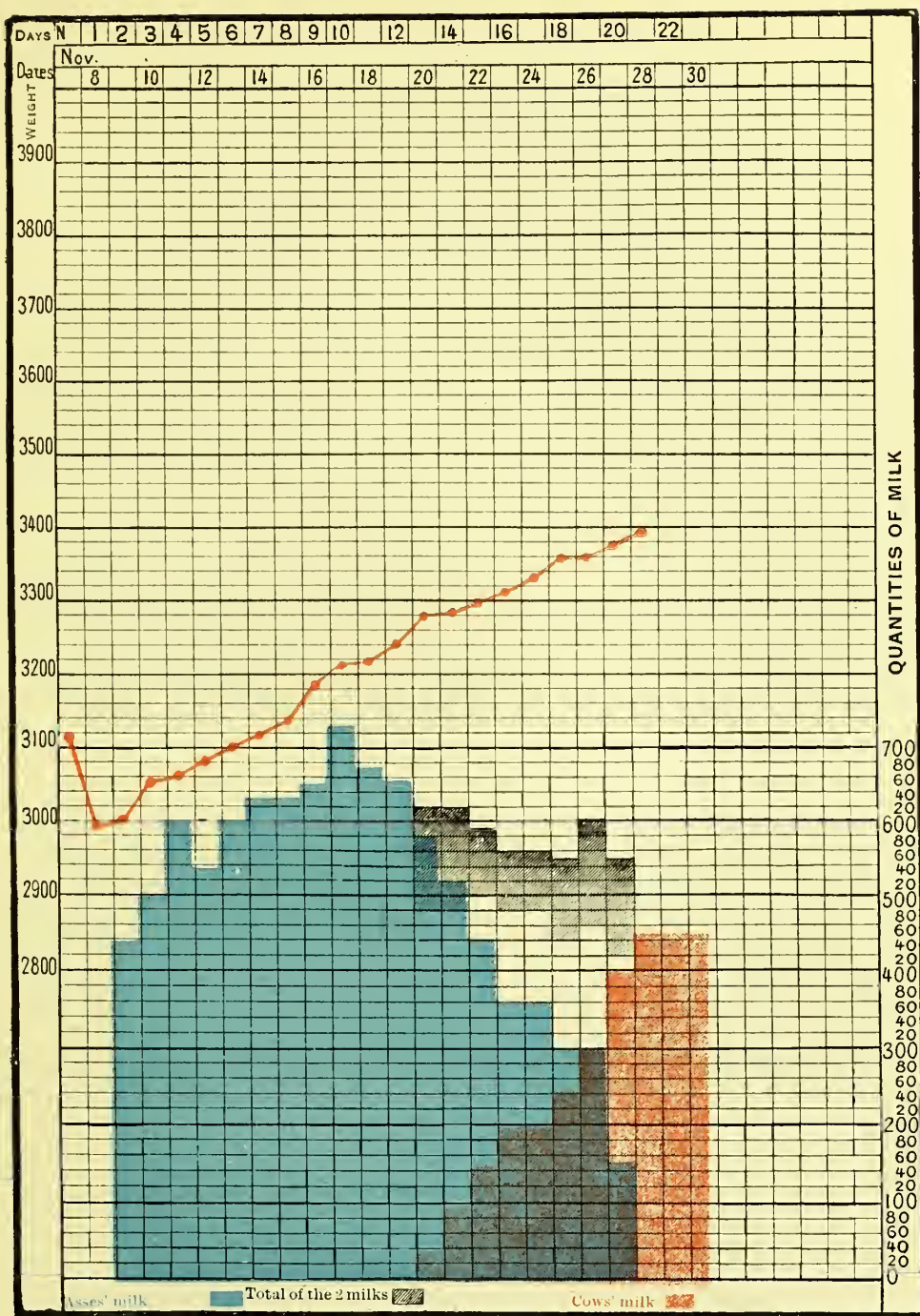


FIG. 102.—Hare-lip. Artificial feeding. Of asses' milk 750 grams were required per day, of cows' milk 450. The curve steadily rose.







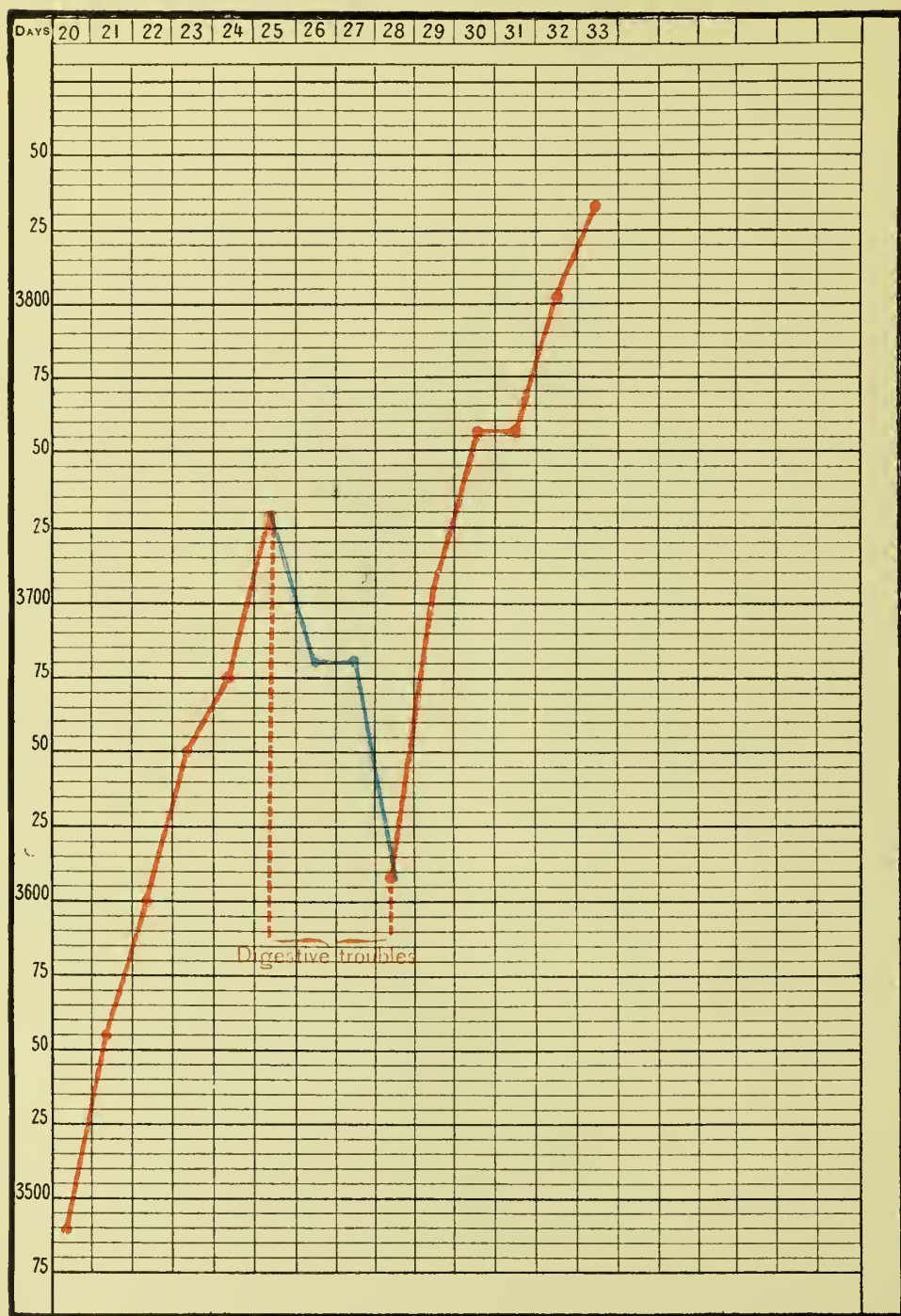


FIG. 103.—Digestive troubles arising from an excessive allowance of milk.

fifth day vomiting began without diarrhœa. I reduced his allowance to 500 grams per day (Fig. 103), and on the twenty-seventh day the vomiting ceased, and the infant commenced normally to increase.

But treatment is not always so rapidly successful. Merle records a case of a child called Roger X——, who was born on January 26, 1894, with a weight of 4000 grams. He was exclusively breast-fed till February 18, when he weighed 4650 grams. The mother's milk then disappeared, and the infant began to lose weight. He was given undiluted sterilised milk, but, as he seemed to support it with difficulty, barley water was added. On April 1 he weighed 7100 grams. He drank greedily; his daily allowance was almost 2000 grams per day, and the inevitable happened; he was seized with colic, diarrhœa, and vomiting, and in five days his weight diminished by 700 grams. The quantity of milk was at once reduced to 1250 grams, and towards April 20 he began slowly to improve. The vomiting ceased, his weight augmented slightly, but, as his mother remarked, "he seemed to be dying of hunger." On April 24 he was given 4000 grams of milk and barley water. On May 25 this amount of pure milk was given. The child continued to grow on the same bizarre scale, so that on July 2, when he was aged five months, he weighed 11,800 grams (Fig. 104).

Parents, midwives, and nurses frequently give enormous amounts of fluid to infants. In one of my cases a nurse gave an infant a few days old 800 grams of undiluted sterilised milk. She seemed astounded when I pointed out that 800 grams per day, for an infant weighing 3 kilograms, was equivalent to 16 litres for the average adult of 60 kilograms ( $800 \times 20 = 16,000$  grams). Although an infant, having to grow as well as to live, requires relatively more than the average adult, this was nevertheless a preposterous amount.

It is more than probable that the evil effects attributed to rearing young babies on undiluted milk are in reality due to overfeeding. Many medical men are now partisans of undiluted milk. Variot<sup>1</sup> states that sterilised milk is well supported by the newly born, and that since its introduction dilution is no longer necessary. During the first six weeks, however, he usually adds one-third of its volume of water and a little sugar. Comby,<sup>2</sup> in 1894, wrote: "Dilution is rarely required, and the sterilised milk

<sup>1</sup> Variot, *Journal de Clinique et de Thérapeutique Infantiles*, Feb. 13, 1893.

<sup>2</sup> Comby, *La Médecine Moderne*, March 14, 1894.

of commerce is perfectly tolerated by even the youngest of infants." Lazard<sup>1</sup> says: "Infants, who are after all the best test of the quality of milk, support sterilised milk admirably. I recommend it undiluted. Experience has taught its great value, for not only is it easily tolerated by healthy infants, but it is also the best remedy in certain cases of diarrhoea, and has saved marasmic cases veritably from the jaws of death." Drapier,<sup>2</sup> who has obtained such marvellous results at his *crèche* at Rethel, uses only undiluted sterilised milk. Ruffié<sup>3</sup> writes: "On the subject of artificial feeding I am without bias, but the results I have obtained convince me that the use of undiluted sterilised milk, as advocated by Professor Budin, is best. I always recommend it to mothers, for not only has it the merit of simplicity, but it also does away with dilutions and manipulations which tend to compromise the purity of the milk."

Bonifas<sup>4</sup> says: "When I was made Medical Inspector of Nurslings in 1893, I was quite ignorant as to whether infants ought to receive milk diluted with much or little water. The authorities I consulted were at variance; as some wished to dilute it at least by half, and others to give it pure, I resolved to test the matter for myself. After two years of minute investigation, I am firmly convinced that undiluted milk should be given during the first months, and even weeks, of an infant's life. This is not an opinion, it is a logical conclusion from a mass of facts."

Gillet,<sup>5</sup> an authority on infant hygiene, discusses the question as follows: "Formerly, practitioners had no definite rules to guide them in artificial feeding, for prominent writers disagreed. Now it is otherwise: undiluted sterilised milk has solved the difficulties. I invariably prescribe it, and I have never seen any ill effects from its use. For a few days after birth some infants do not tolerate it well, and for them it may be slightly diluted for a short time. However fixed the question may seem in theory, there is no immutable law in practice, and the most suitable diet for any particular child can be ascertained only by experiment; but

<sup>1</sup> Lazard, *Journal de Clinique et de Thérapeutique Infantiles*, 1895, p. 886.

<sup>2</sup> Drapier, *Rapport sur le fonctionnement de la Crèche Hippolyte Noiret pendant l'année 1895*. Union Médicale du Nord-Est, 1896.

<sup>3</sup> Ruffié, *La Gouttette ou la Diarrhée verte des Nourrissons et son Traitement par le Lait Sterilisé*, Paris, 1899.

<sup>4</sup> Bonifas, *Le Progrès Médical*, Feb. 24, 1900, pp. 113-116.

<sup>5</sup> Gillet, *Formulaire d'Hygiène Infantile Individuelle*, Paris, 1898, p. 113.

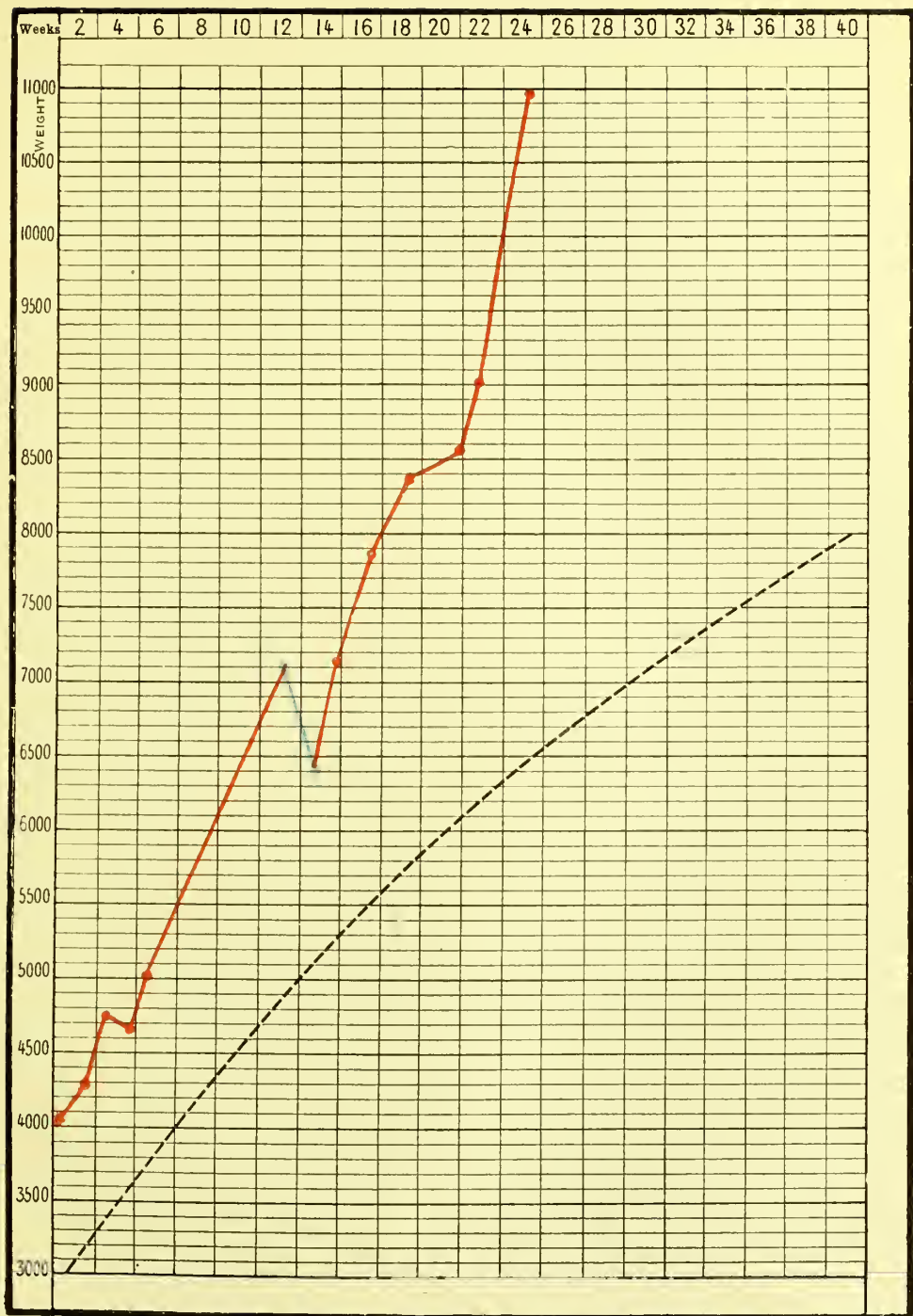


FIG. 104.—Digestive troubles due to over-feeding.





undiluted sterilised milk will be found to answer in most cases. The method of dilution has for its object the approximation of the composition of cows' milk to that of human milk. This is only one of the desiderata in artificial feeding, and one to which we, nowadays, attach much less importance than heretofore."

At our next meeting we shall study how much undiluted sterilised milk an infant ought to receive.

## LECTURE IX

SUMMARY:—Artificial feeding—How much cows' milk ought to be given to a nursling?—Tendency to overfeeding—Its risks—Immunity of underfed infants from digestive troubles.

The balance the guide—Successful cases of artificial feeding with undiluted sterilised milk—Necessity for supervision—Dangers of artificial feeding.

Weaning.

Alleged evils of artificial and mixed feeding—Their true cause.

GENTLEMEN,

In our last lecture we began the study of artificial feeding, and I laid stress upon the great value of cows' milk, undiluted and sterilised, as a food for infants.

How can we determine the amount to give in any particular case? The capacity of the stomach is too difficult to estimate, and varies too much, to serve as a guide. Neither is the age of use as a standard, for sometimes an infant weighs 2600 grams at term and sometimes 5000 grams, and this want of uniformity is present at all ages. The weight of the infant would probably furnish a better indication, yet the assimilative power varies in infants of the same weight according to the state of the digestive tube and the composition of the milk. These are factors which further complicate the problem.

The general tendency is towards overfeeding, and I would impress upon you my former remark: "Infants who are underfed are free from digestive troubles. They do not gain weight, but, by gradually increasing the quantity, it is easy to attain in safety an adequate diet for any given case, and then the child will grow rapidly." This is the ruling principle in my work. Each new case is a fresh subject for investigation. For the first few days I always prefer to err by giving too little than by giving too much. Having gradually reached the requisite amount for the nursling in question, I do not increase it unless I am thoroughly convinced of the necessity.

A few examples will enable you better to grasp the details of my method.

A woman named Liv—— was confined on April 19, 1897, of

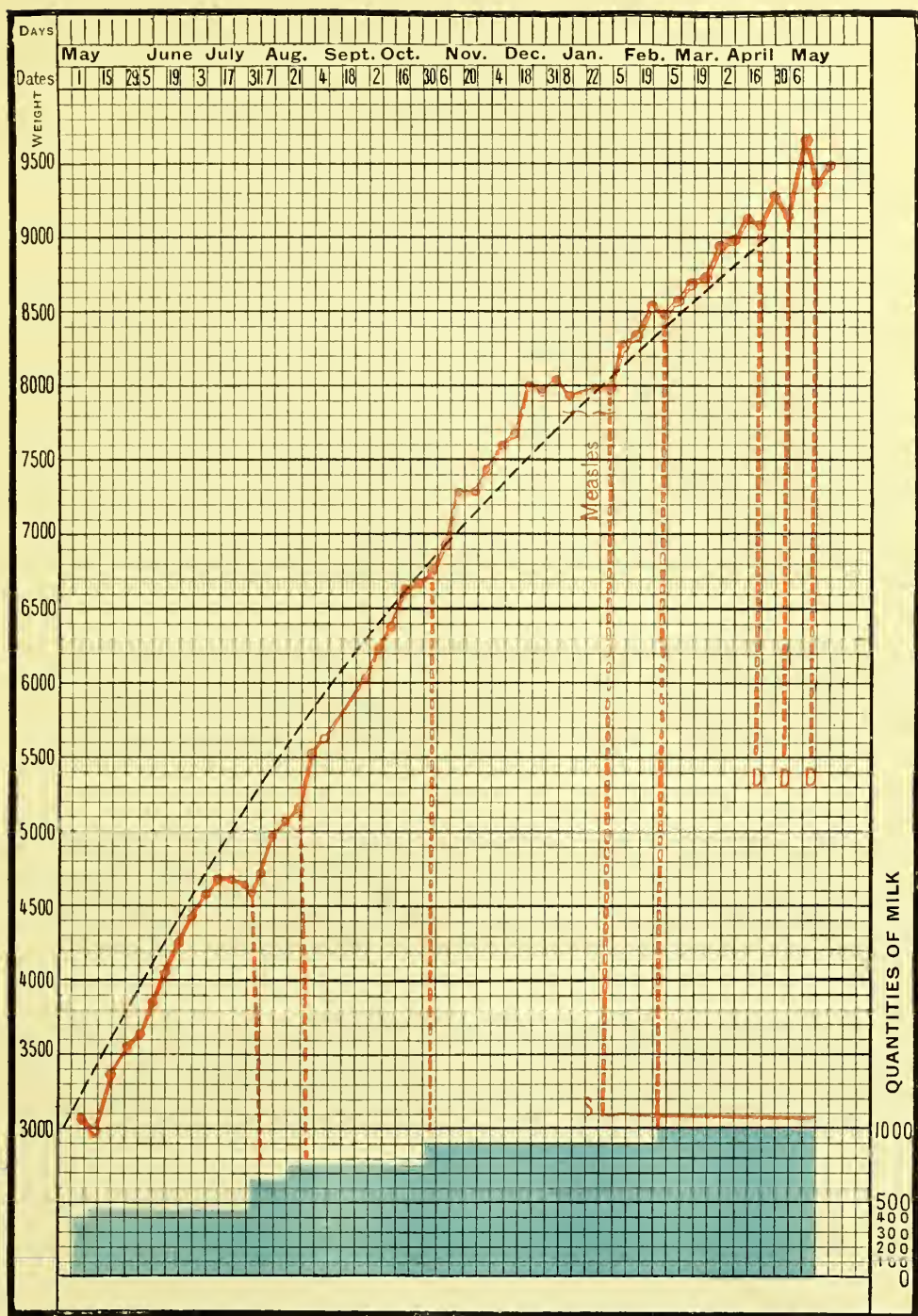


FIG. 105. Quantities of pure milk taken by an infant on artificial feeding.







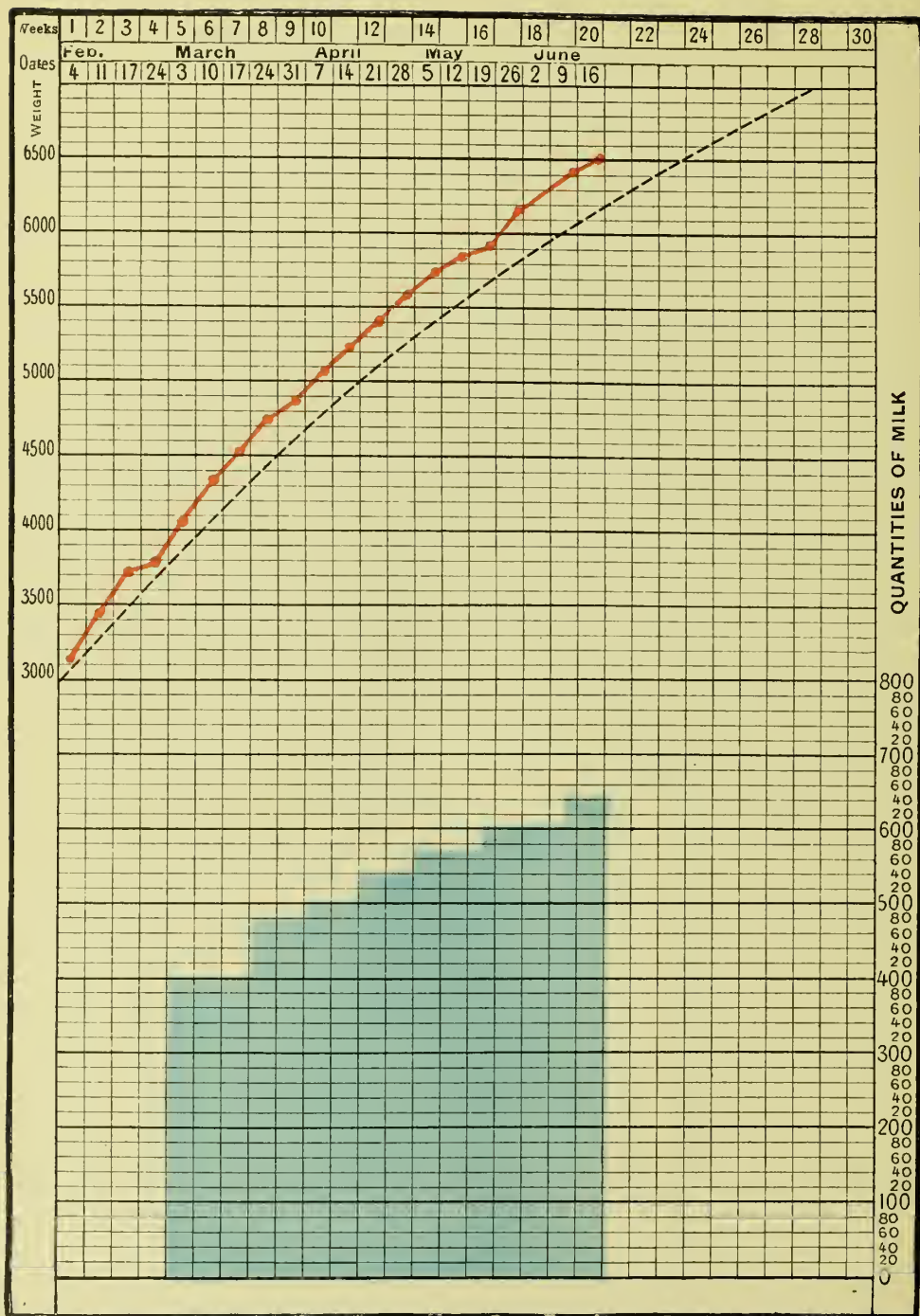


FIG. 106.—Showing the quantities of undiluted milk taken by an infant on artificial feeding.

her third child. She had never been able to suckle. The chest was quite flat, the mammary glands were undeveloped, and the nipples were represented only by depressions. She came to the Consultation on May 1. Her infant weighed 3050 grams, and I prescribed 400 grams of sterilised milk per day, divided into eight feeds. On May 8 he had lost 80 grams. I examined him carefully: as he seemed in perfect health, the only possible explanation of the decrease in weight was that he was being underfed. I raised his ration to 450 grams. In one week he had gained 390 grams, and he continued to thrive, so this quantity of milk was obviously sufficient and remained unaltered. From July 17 to 24 he had a slight attack of diarrhoea, which was quickly cured by small doses of calomel. In the ten days ending July 27 he lost 90 grams, and was very irritable after each meal. Thinking he was getting too little, I increased his allowance to 675 grams per day, and in the following week he gained 250 grams. Similarly, on August 21, he had gained only 60 grams in seven days. I raised the daily amount of milk to 750 grams, and during the next week he increased at the average rate of 51 grams per day. On October 30, 900 grams were given, and on January 29 a little farinaceous food was added to the milk at one of the feeds, so as to make what we call a "soup." On February 26 the milk was increased to 1000 grams. The weight of this infant described practically the normal curve (Fig. 105). My first estimate of its needs, 400 grams of milk, was too small, but when I arrived at the amount sufficient, 450 grams, the child increased in weight by 390 grams in one week. From time to time, when I found he was not progressing to my satisfaction, although his digestive tube seemed to be acting normally, I slowly augmented his daily allowance, and on each occasion the curve rose abruptly.

A baby boy, J—M—, was born on February 1, 1898, with a weight of 3150 grams. At first he was suckled by a wet-nurse, whose milk, however, not being quite sufficient, was supplemented by asses' milk. On my return to town after three weeks' absence I found that the wet-nurse, having lost her milk, had weaned the child. Greatly against my inclination I continued to feed him artificially. On my prescribing cows' milk, undiluted and sterilised, in carefully graduated quantities, he enjoyed complete immunity from all digestive troubles, and his curve rose superior to the normal (Fig. 106). The wet-nurse, although no longer able to suckle, was retained; she was very intelligent, but her zeal for

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the child's welfare often put a great strain on her obedience. One could hardly conceive the difficulty I had in preventing her from overfeeding the infant. She was haunted with the idea that he was not getting enough; she was openly displeased at his rate of growth, and pestered me to give him more milk. But as I traced his curve from week to week and found it uniformly above the average, I resisted her importunity to the best of my ability, and gave way only when I thought an increase in his allowance was absolutely necessary.

The milk given to this infant was of excellent quality, as it contained on several analyses 40 to 41 grams of butter. It is remarkable how small an amount the infant required.

He was given 400 grams when he weighed 4070 grams.

"	"	480	"	"	"	4800	"
"	"	540	"	"	"	5400	"
"	"	570	"	"	"	5800	"

In fact the amount he absorbed corresponded to about one-tenth of his total weight.

A woman named Leq—— was confined at the Maternité on December 15, 1893, of a son who, when he left the hospital ten days later, weighed 3050 grams. The mother, unable to rear him herself, through having to work for her living, entrusted him to a woman in the country. We did not see him again till July 8, on which date the mother, having gone to visit him and finding him ill with diarrhœa, and in a wretched condition, brought him to us. He had been as one of the family, the wet-nurse had protested, and in all their food, meat, vegetables, &c., he had shared. In the 195 days since his departure he had gained only 2600 grams (Fig. 107).

I prescribed eight bottles of 75 grams, *i.e.* 600 grams of sterilised milk per day, and on July 15, having gained on an average 31.4 grams per day during the week, he weighed 5870 grams. On August 19 the mother left town, and I carefully instructed her to give him the same amount of milk till her return. The infant weighed 6820 grams, and in the previous forty-two days had gained on an average 28 grams per day.

She came back on September 23. During the interval her child had suffered almost continuously from diarrhœa, and having gained on an average only 13.8 grams per day, he now weighed 7300 grams. On September 28 he was given eight bottles of 75 grams, *i.e.* 600 grams of sterilised milk per day. On September 30 the digestive troubles had quite disappeared, but the weight was



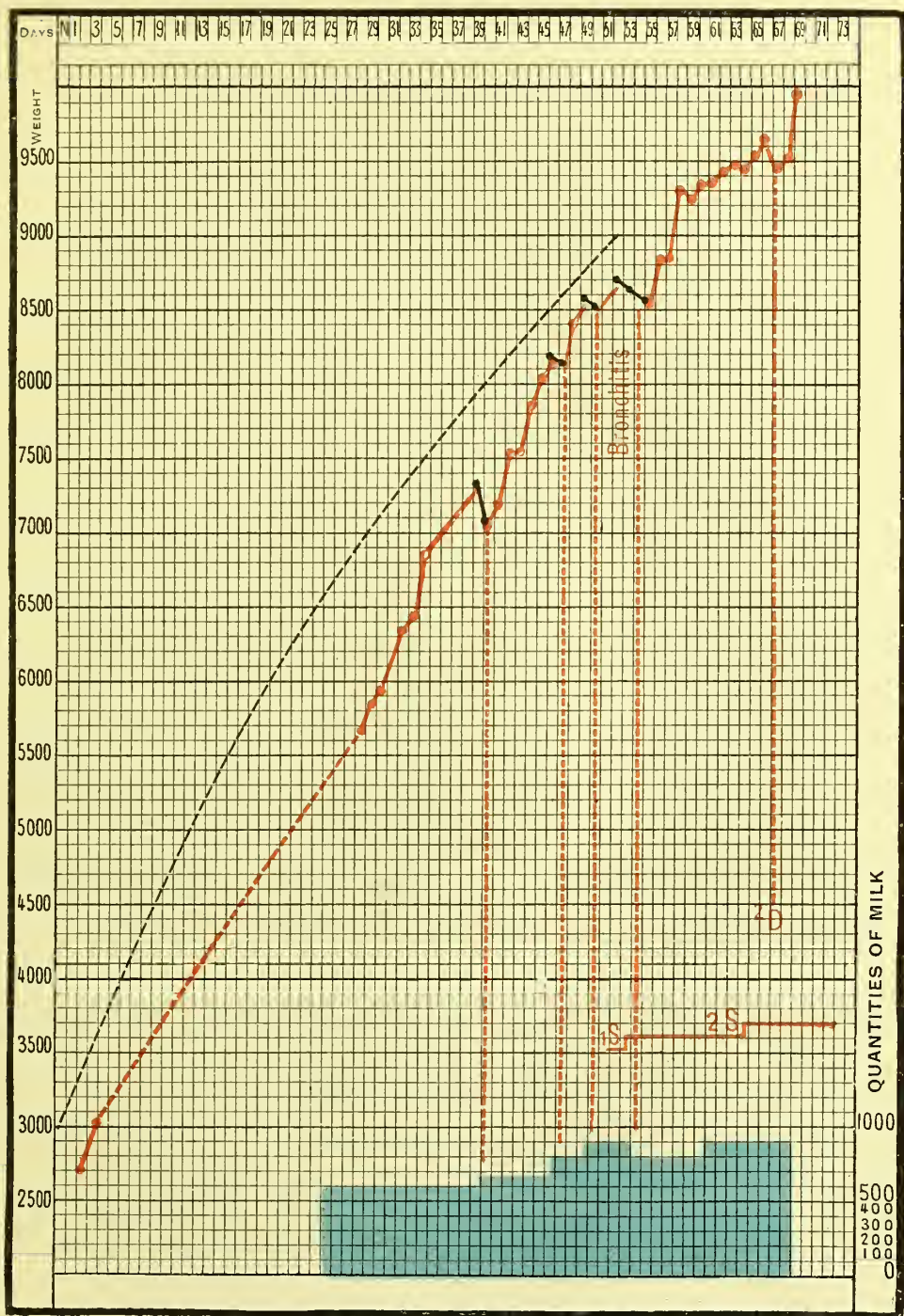


FIG. 107.—Artificial feeding. Curve of the infant Leq—, showing the daily quantities of milk he took.







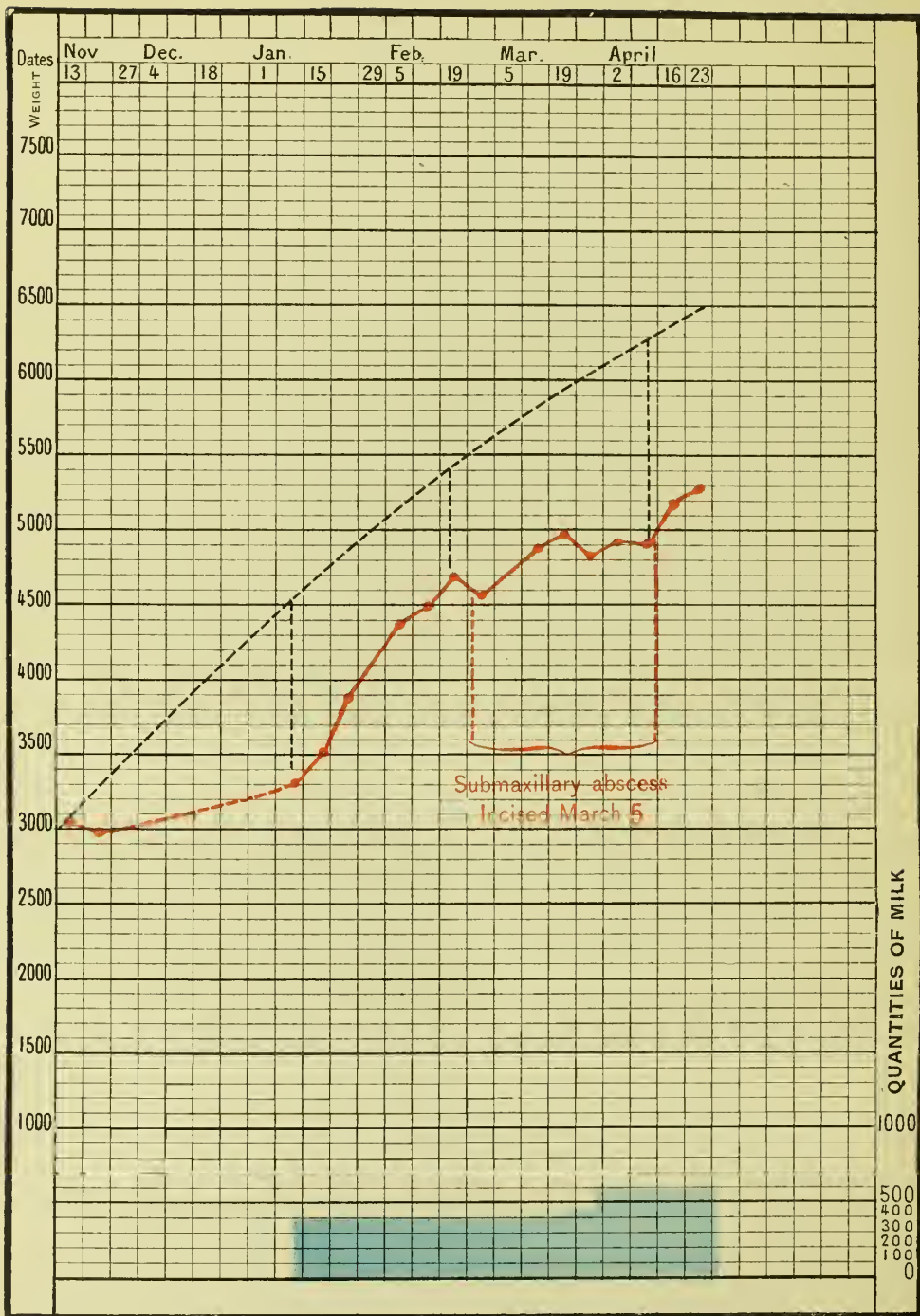


FIG. 108.—Infant badly fed by a wet-nurse. Curve showing the results of regulated feeding by undiluted, sterilised cows' milk. Daily quantities of milk indicated in blue.

only 7030 grams. His daily allowance was inadequate: 600 grams of milk for an infant weighing 7030 grams was not enough. I increased it to 675 grams per day, and in a fortnight he had gained 470 grams. He progressed steadily till the week ending November 18, in which I found he had lost 70 grams. He was perfectly healthy: he weighed 8120 grams, and absorbed 675 grams of milk per day. As this was evidently insufficient, I gave eight bottles of 100 grams, and he began again to increase in weight. On December 9 his ration was raised to 900 grams, and on December 23 he was given one "soup." Shortly afterwards he caught a bad cold; he lost his appetite, and his weight diminished. He did not take all his milk, so I reduced it to 800 grams per day. Once cured, he rapidly gained the weight he had lost. On February 10 I found, at his weekly weighing, that he had lost 70 grams. He then weighed 9230 grams, and was getting only 800 grams of milk per day and one "soup." He was given 900 grams, and his curve rose steadily till it attained the average height to which hitherto it had been inferior.

Here is another interesting case. A woman named Bon—— was delivered at the Maternité on November 13, 1897, of an infant weighing 3000 grams. In due course she left the hospital, and put her child out to nurse. She returned on January 8, 1898, bringing the infant, a letter, and a certificate. The letter was written on paper with a gorgeous floral design round the margins; it was dated December 30, and conveyed the congratulations of the wet-nurse to the proud mother on the splendid progress her infant was making. She also wished the mother a happy New Year, and gently recalled the fact that January 1 was the time for handsels.

A few days later a certificate arrived from the local doctor to say that the child was so ill as not to be able to support cows' milk, and that breast-feeding was indispensable. The poor woman immediately sought her child, and found it in a state of collapse, suffering from diarrhoea. Its diet had been boiled bread and milk, and since birth it had gained only 370 grams (Fig. 108). I recommended a breast wet-nurse, but as nothing would induce the mother again to part with her little one, I consented to try sterilised milk, and prescribed 400 grams per day. On January 15 the digestive troubles had greatly diminished, the new diet was being admirably supported, and the weight had increased by 200 grams in seven days. On this small amount of milk the infant continued to thrive until March 19, when I had to give 450 grams. The weight was



then 5000 grams. A submaxillary abscess appeared on March 5, and had to be incised. This slowed the child's growth for a time, but after it healed the weight-curve steadily rose.

The following observation shows how easy it is to give excess to infants. A woman named Lech—— was delivered of twins on May 8, 1898. When they left the hospital ten days later, the one, Albert, weighed 3410 and the other, Louis, 3250 grams (Fig. 109). The mother not having sufficient milk to satisfy both, I gave them each two 50-gram bottles of sterilised milk per day. On this amount they continued to thrive till July 11, when it became necessary to increase it first to 150 and then to 200 grams each per day, for the mother was gradually yielding less and less.

On October 3 they returned from a two months' stay in the country. I had given the mother a steriliser, so that she might suitably prepare their milk during their absence from the Consultation. I now found that she had weaned them completely, and was giving each a daily allowance of 1000 grams of undiluted sterilised milk. They were in perfect health, and weighed precisely the same, 7860 grams.

The large amount they absorbed made me somewhat anxious regarding them. According to my experience, it was certainly excessive; I therefore reduced it to 800 grams per day for each. This quantity was quite large enough; their growth continued uninterruptedly, and their curves rose steadily (Fig. 109). On December 5, when they weighed 9220 and 9140 grams respectively, their daily supply was increased to 900 grams. You saw them the other day, two big, strong boys, each well worthy of the name he bears, Lechêne.<sup>1</sup> This case also demonstrates the easy transition from mixed feeding to weaning.

When infants are suffering from digestive troubles, it is necessary first to cure them before proceeding to determine how much milk they require for their daily needs.

On July 27, 1897, a mother brought her dying infant to me. He had been born on May 11, and since birth had gained only 20 grams. He was suffering from diarrhoea and vomiting, and was being fed only on chicken broth. I prescribed 450 grams of sterilised milk per day; the infant supported it splendidly, rallied, and soon began to gain weight, although the diarrhoea persisted more or less till the beginning of October. On July 31 he weighed 3300 grams, and on August 7, 3350. He was given nine bottles of 25 grams of

<sup>1</sup> The oak.



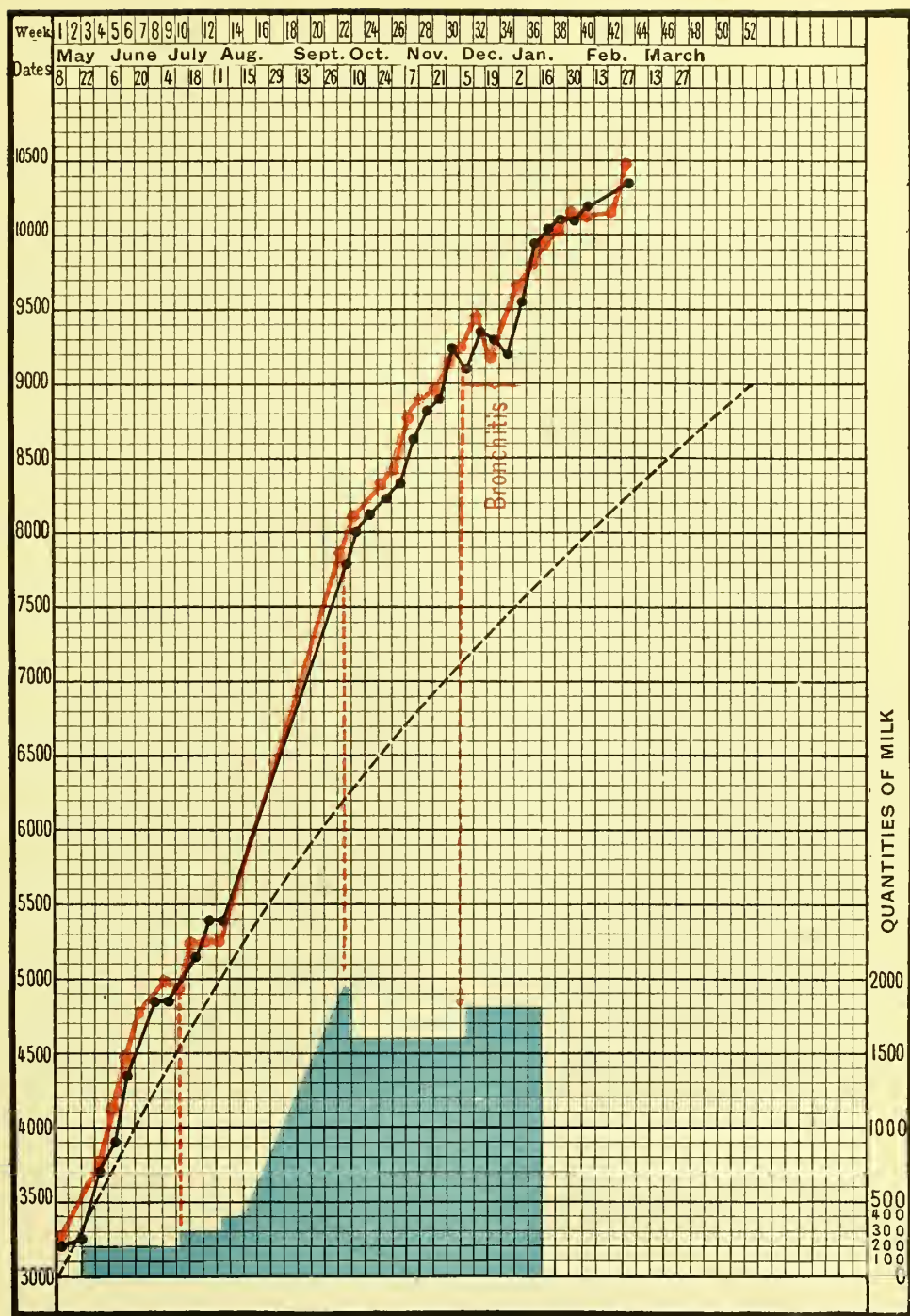


FIG. 109.—Mixed feeding of twins. At first a small quantity of cows' milk sufficed, but the mother went to the country, and in spite of my advice greatly increased the amount. On her return I diminished it. Quantities of cows' milk taken per day are indicated by the blue columns.





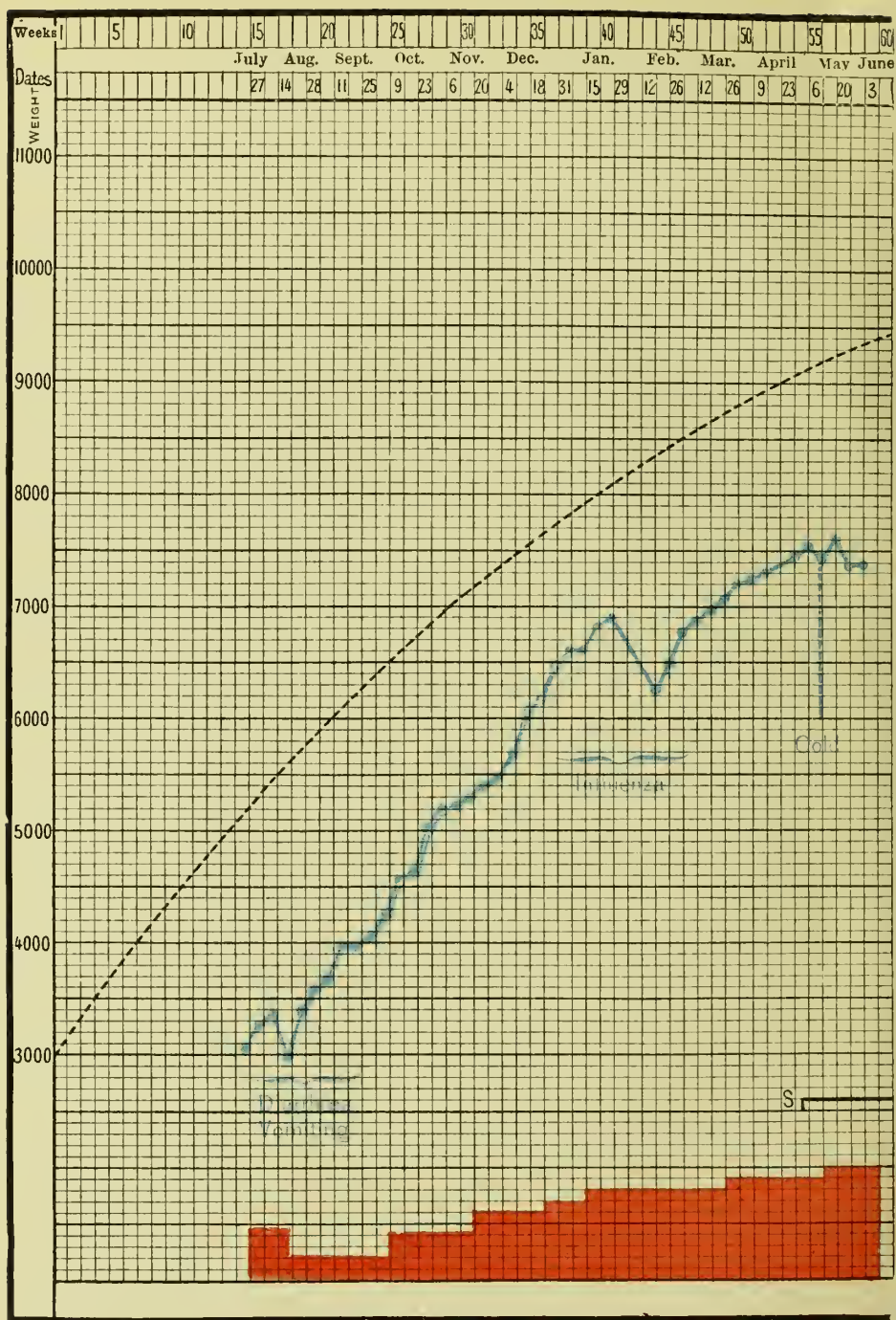
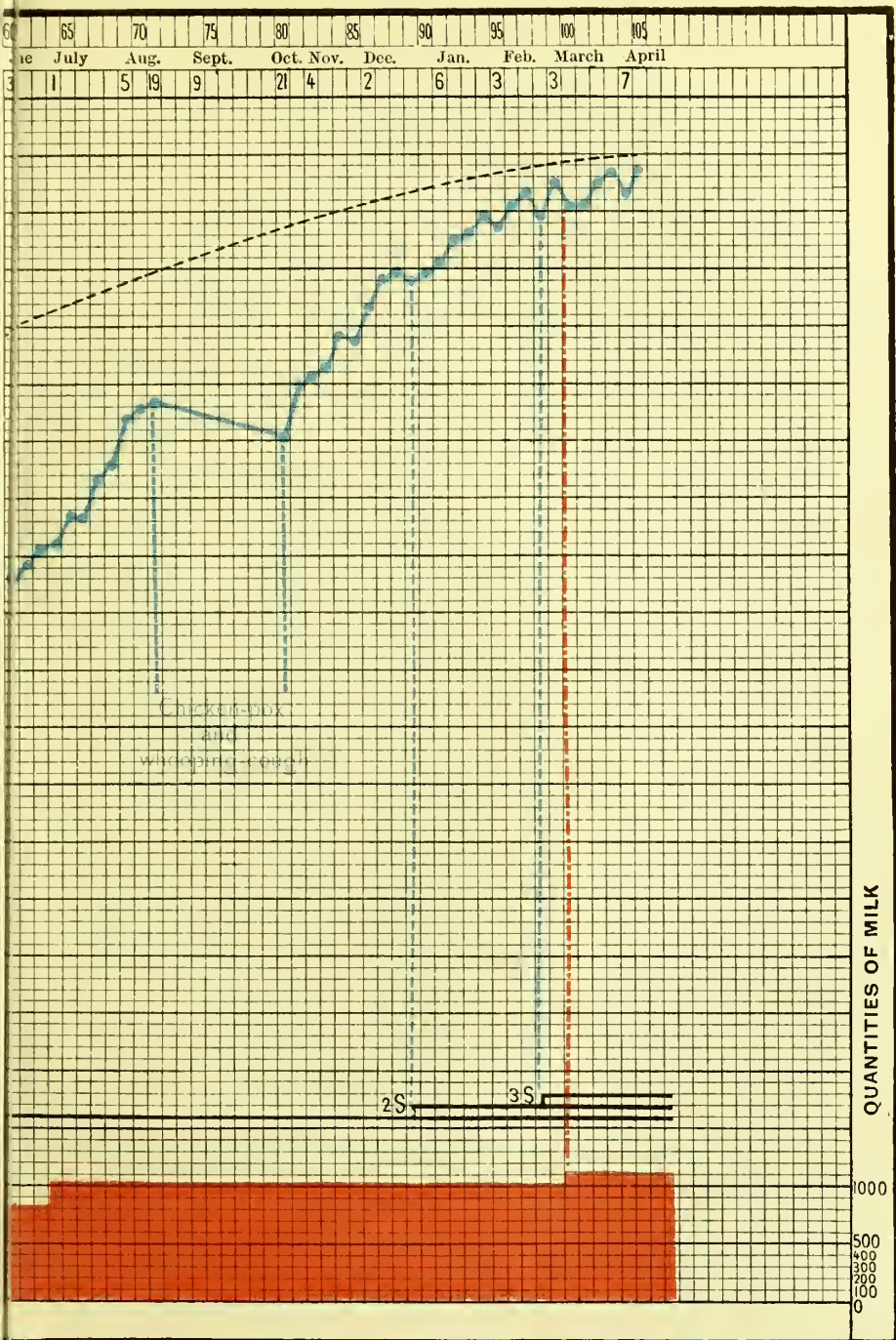


FIG. 110.—Infant admitted in a dying state, suffering from diarrhoea and vomiting.  
on the infant's weight. Quantities





artificial feeding—recovery. Curve shows the effect of various contagious diseases  
milk per day in red.





sterilised milk, which was a daily allowance of only 225 grams. His weight fell to 2950 grams, but the diarrhoea and vomiting now began to subside, and soon he reached 3500 grams. He continued to thrive till October 2, when his daily milk supply was raised to 450 grams, which on November 20 was further increased to 600 grams. In spite of influenza, a cold, chicken-pox, and whooping-cough, each of which left its impress on his curve (Fig. 110), little "Chicken Broth," as he was called in the wards, weighed 11,100 grams when he was two years old. His daily ration then consisted of 1125 grams of sterilised milk and three "soups" per day.

An infant was brought in March 1899, weighing 5420 grams. Born on July 30, 1898, he had since gained 2420 grams, which was a daily average of only 11 grams. He was absorbing  $1\frac{1}{2}$  litres of milk, diluted with 1 litre of water, *i.e.* 2500 grams per day. The mother was certain that he was yet underfed, for he cried, "as if still hungry," after every meal. 2500 grams for an infant weighing 5420 grams is equivalent to a daily allowance of 28 litres for the average adult of 60 kilograms. In spite of this enormous quantity the infant was practically a skeleton; his face was seared with wrinkles; his ribs were beaded; and the huge size of his abdomen formed a striking contrast to his emaciated condition. He was very constipated, and incessantly passing urine.

How was he to be dieted? As his stomach was dilated it was out of the question to start with the average amount required by an infant of his weight. I prescribed, amidst vehement protests from the mother, nine bottles of 125 grams, *i.e.* 1125 grams of undiluted sterilised milk per day, and on March 17 he weighed 5700 grams. During these eight days his average daily increase had risen from 11 to 40 grams. I then essayed to reduce his allowance to 900 grams, but on March 24 I found he had lost 60 grams since the previous weighing. As 900 grams was evidently not enough, once more I reverted to 1125, and the curve resumed its upward course. On April 21 I again tried 900 grams, and again failed, for he lost 80 grams in seven days. I substituted 1080 grams, and on this allowance he reached 6530 grams on May 12. Again I ventured 900 grams, this time with success, as you can see from his curve. He continued steadily to increase, and on May 26 reached 6950 grams. Dieted thus, he had gained on an average 33 grams per day for forty-six days. He was now taking only 900 grams of milk, instead of 1500 grams of milk and 1000 of water, and the wizened,

ancient-looking little creature was transformed into a plump, contented, and thriving infant.

Artificial feeding gives excellent results, but only so long as it is attentively supervised. This fact was strikingly exemplified in the history of the infant Leq—— (Fig. 107, p. 136), and I wish further to emphasise it by briefly narrating two other cases which demonstrate the importance of carefully regulating the quantities of milk which the child receives.

The infant D——, born on March 23, left the hospital on April 1, weighing 3965 grams (Fig. 112). Breast-fed, he grew steadily, and on July 7 reached 6980 grams. The mother, having taken him to the country, weaned him, and fed him with 1000 grams of cows' milk and two "soups" per day. When he returned to the Consultation on November 10, he weighed 7420 grams. In 126 days he had gained 440 grams, which was an average of only 3.5 grams per day. His curve during this period described almost a horizontal line. I regulated the quantity of milk he daily received, and on December 8 he weighed 8405 grams. In four weeks he had gained 985 grams, and had thus increased at the rate of 35 grams per day. His diet was carefully adjusted from time to time, and his curve, except for some small oscillations due to bronchitis and teething, steadily rose. At twelve months he weighed 9480 grams, and had eight teeth.

An infant named S—— was brought to our Consultation on April 14, 1893, weighing 3040 grams (Fig. 113). Ten bottles, each containing 50 grams, were given to him, and his curve made a regular ascent. On July 21 he weighed 5330 grams, and on October 13, 6840. The mother then ceased to come for a time, and when next we saw the child, on May 4, 1894, he weighed 8430 grams; in 203 days he had increased by only 1590 grams. His curve had entirely changed its direction; it had steadily sunk below the normal, to which formerly it had been proceeding parallel.

Boissard records a case which strikingly illustrates the difference between the results of well-regulated and haphazard artificial feeding. An infant H——, born at the Hôpital Tenon, weighed when he left on March 19, 1899, 3150 grams. He had then been twenty-nine days in the wards, and had gained 620 grams. The infant was artificially fed, for the mother had no milk. He was given carefully regulated quantities of undiluted sterilised milk, and on April 8 he attained 3770 grams, which was an average increase of 31 grams per day for twenty days (Fig. 114). The mother

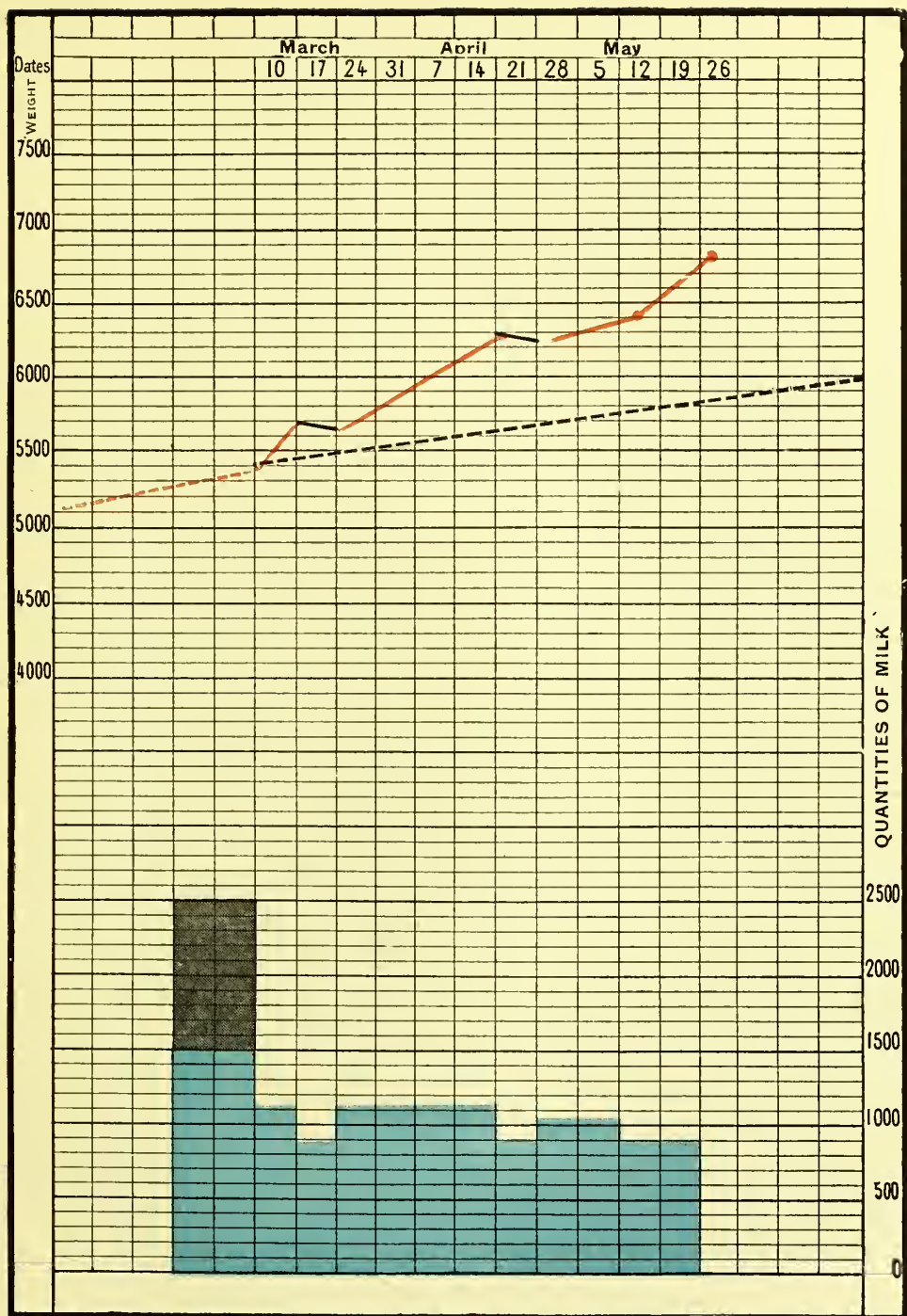


FIG. III.—Curve of a rachitic admitted to the Consultation. His daily allowance was 2500 grams of fluid. I first gave him 1125 grams of undiluted milk, which I ultimately succeeded in reducing to 900 grams.







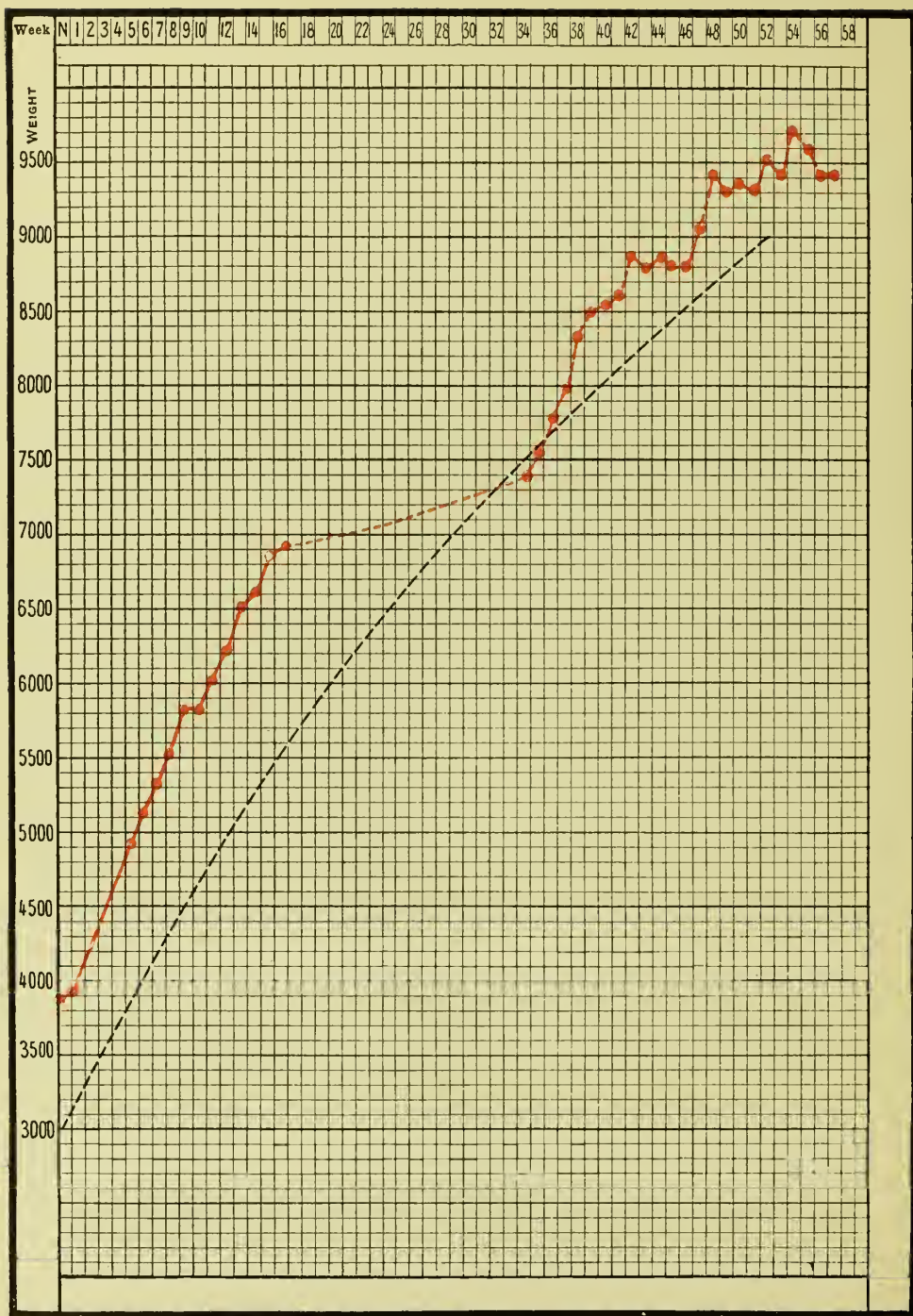


FIG. 112.—Curve of an infant who, while attending the Consultation, was breast-fed. Mother went to the country and weaned him. His weight during this period was practically stationary. When the artificial feeding was properly directed his curve rose. The interrupted red line represents the curve during his absence from the Consultation.

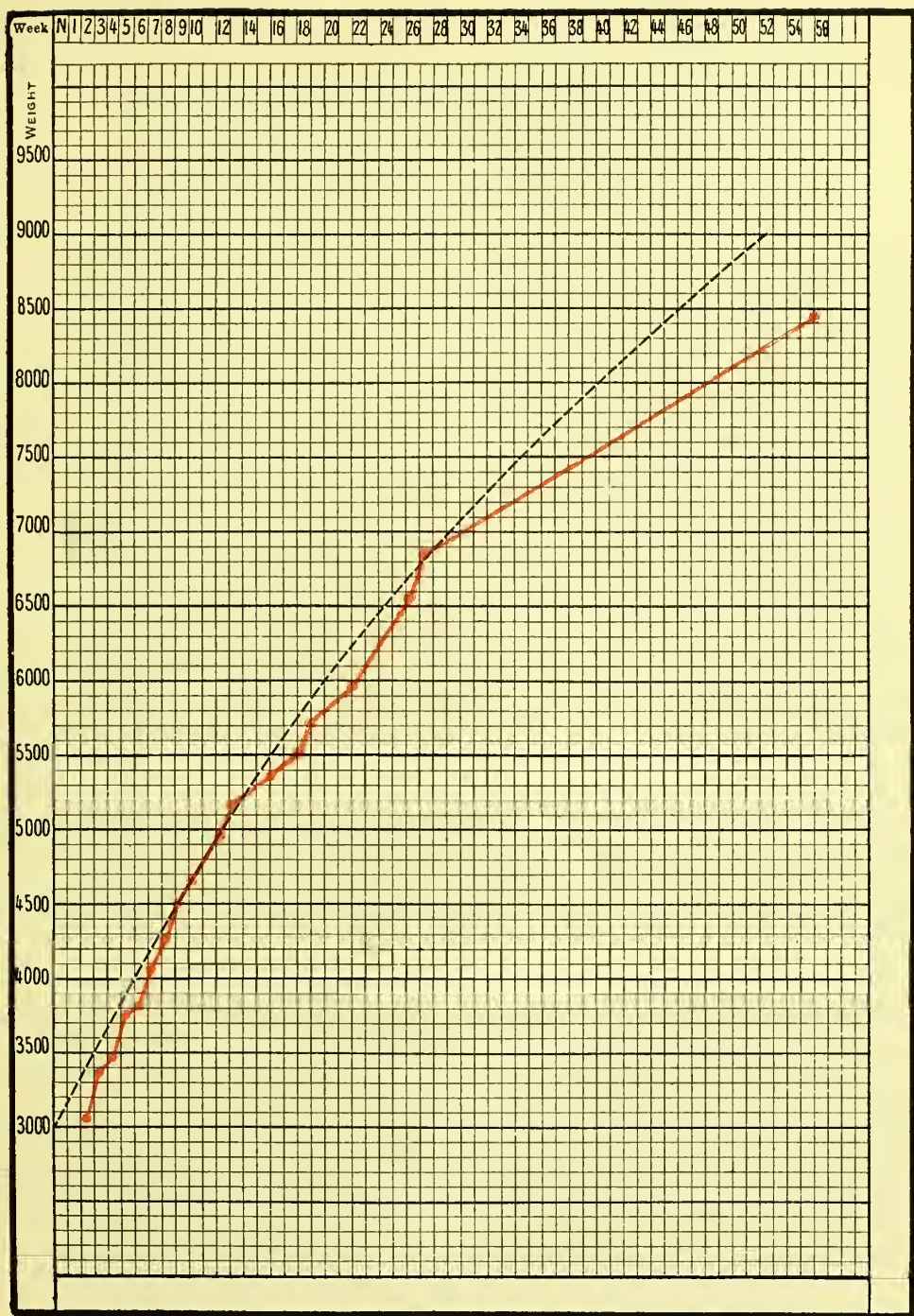


FIG. 113.—Artificial feeding. Curve of infant S—. Ceased to attend the Consultation on the twenty-seventh week; returned on the fifty-sixth. Observe the change in direction of the curve during this period.







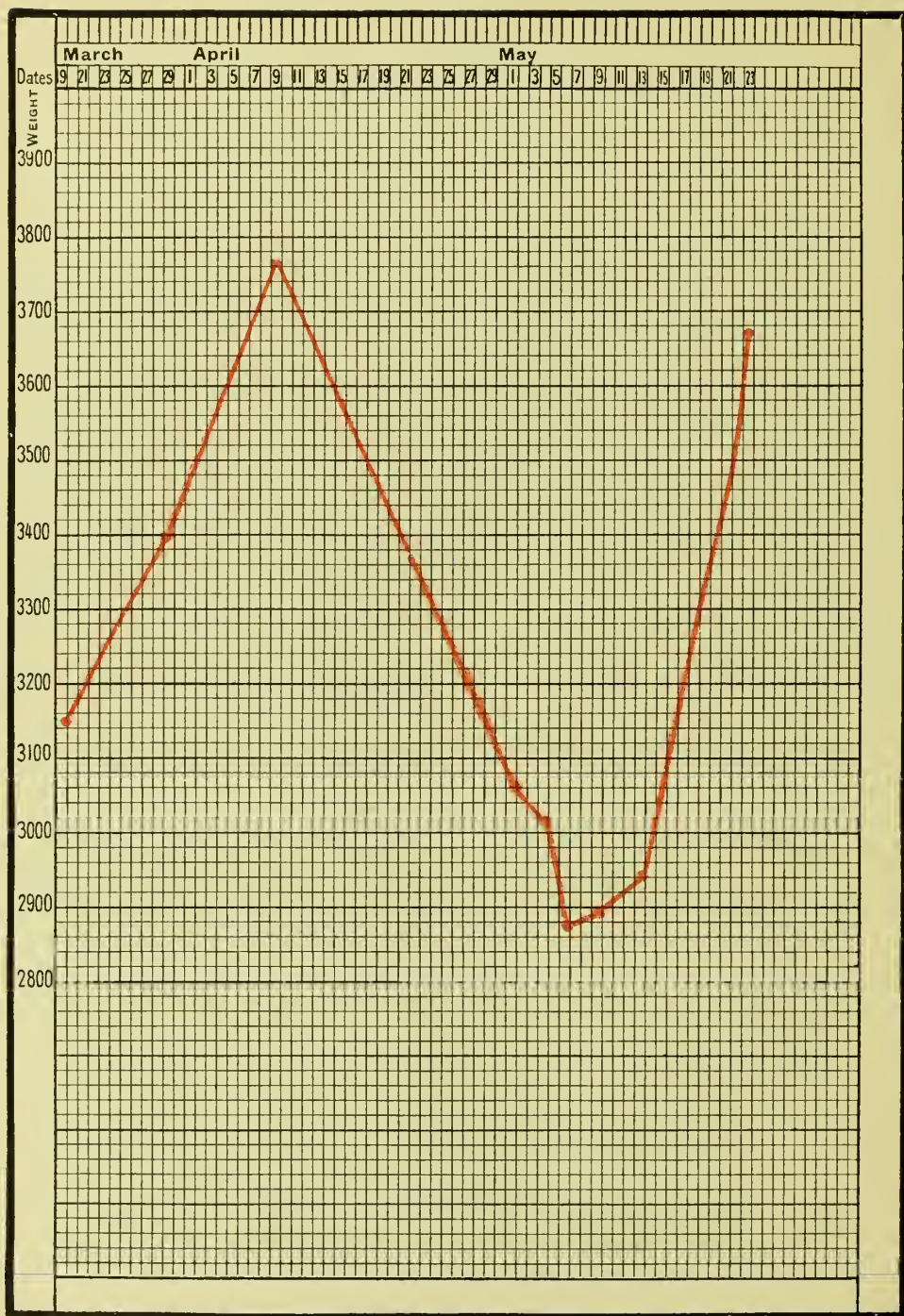


FIG. 114.—Artificial feeding carefully supervised, the infant grew normally; badly directed, the infant had diarrhoea and lost weight; feeding again properly regulated, diarrhoea ceased and the infant rapidly increased (Boissard).

became ill, and was admitted with her child into another hospital. The infant was still fed on sterilised milk, but his weight diminished considerably, and on May 1 he weighed only 3080 grams. In spite of her great weakness the mother, afraid for the life of her child, insisted on leaving the hospital, and carried her little one in all haste to M. Boissard, who found the infant much emaciated, and suffering from an acute infectious diarrhoea. Sterilised milk in small and accurately graduated amounts was given till the digestive tube recovered its normal healthy state. The infant began once more to increase, and on May 23 weighed 3680 grams, his curve, as you see (Fig. 114), then assuming the normal aspect.

Notwithstanding its success, artificial feeding by means of sterilised milk is vastly inferior to breast-feeding. I cannot insist too much upon this. The mother's milk, or that of a good wet-nurse, should always be given where possible, for it is the easiest to digest and entails least risk to the nursling. I have already referred to the case of the twins Leu——, who were born at the Maternité on December 10, 1893. The mother not having enough milk for both, we had recourse to mixed feeding, and I gave her a sterilising apparatus, as she lived far from the Consultation. The infants thrived, and their curves steadily rose superior to the normal. On Saturday, July 1, the mother was obliged to entrust them to a neighbour for the day while she went to Paris to transact some business. On her return next morning she found them both suffering from diarrhoea and their weights fallen, the one by 600 the other by 370 grams (Fig. 96). Under their mother's loving care they quickly recovered, but their history strikingly illustrates the ease and rapidity with which digestive troubles arise when artificial feeding is improperly directed. If the sterilisation is not perfect, if a bottle is left for some time uncorked, if the milk is of bad quality—in fact, if there is any want of care in conducting the feeding—accidents may happen which, especially in summer, quickly assume an extreme gravity. The smallest error or the slightest negligence allows organisms to penetrate the milk, which, once contaminated, becomes a menace to the infant's safety. When, on the other hand, a nursling takes the breast, it may not always obtain a perfect milk, but it gets, at least, a sterile food, and enjoys immunity from acute infectious diarrhoeas.

If mixed or artificial feeding be a necessity, there are three cardinal laws which govern the use of animal milk. 1st. Give milk of good quality. 2nd. Give milk in correct quantities, neither too

much nor too little ; and 3rd. Sterilise all milk. The small graduated bottles, which each contain only enough for one feed, are of the greatest service, for they prevent excess not only in the daily allowance but also in the individual meals.

I shall conclude by placing some of my results before you, but I wish first to direct your attention for a moment to several points, reference to which I must not neglect.

With regard to the reappearance of the menses in a nursing woman, I shall not reiterate what I have already said. You have seen that some menstruating women are good nurses while others are not. At the menstrual periods nurslings may have digestive troubles, and this applies not only to frail and sensitive weaklings (Fig. 65, p. 94), but equally to children born at term. You may recollect the instructive curve of the infant Calm——, upon which the mother's periods imprinted themselves as a series of notches indicative of the temporary loss of weight (Fig. 67).

Has the evolution of the teeth any real influence on the infant's general health ? Hippocrates made the first study of this question, and it does not seem to be settled yet. It is a subject well worthy of minute investigation. Many infants cut their teeth without any signs of a general disturbance. Some present symptoms recurring at the piercing of each tooth, for which on careful examination no cause can be detected other than the dental evolution. The child seems out of sorts ; he is restless, fretful, and sleepless ; he may have diarrhœa, colic, and other troubles, all of which disappear the moment the tooth emerges through the gum. To-day I wish to restrict my examples to a few, significant of the accompanying loss of weight.

The curve of the infant Guil——, who was born on July 6, 1896, was at first inferior to the normal (Fig. 115) ; but, when the mother's inadequate supply was supplemented by sterilised milk, the child increased in weight with a most gratifying regularity. Teeth were cut during the 26th, 47th, 48th and 56th weeks, and coincidently with each, as you see, the infant lost weight.

The infant Van der St—— was born at the Maternité on December 6, 1896. At first he was fed exclusively at the breast, but, the supply proving insufficient, mixed feeding had soon to be adopted (Fig. 116). His curve is somewhat mediocre, for the mother's milk gradually dwindled till, early in July, the infant was completely weaned. However, on July 3, when he was six and a half months old, two teeth appeared ; others came through on July



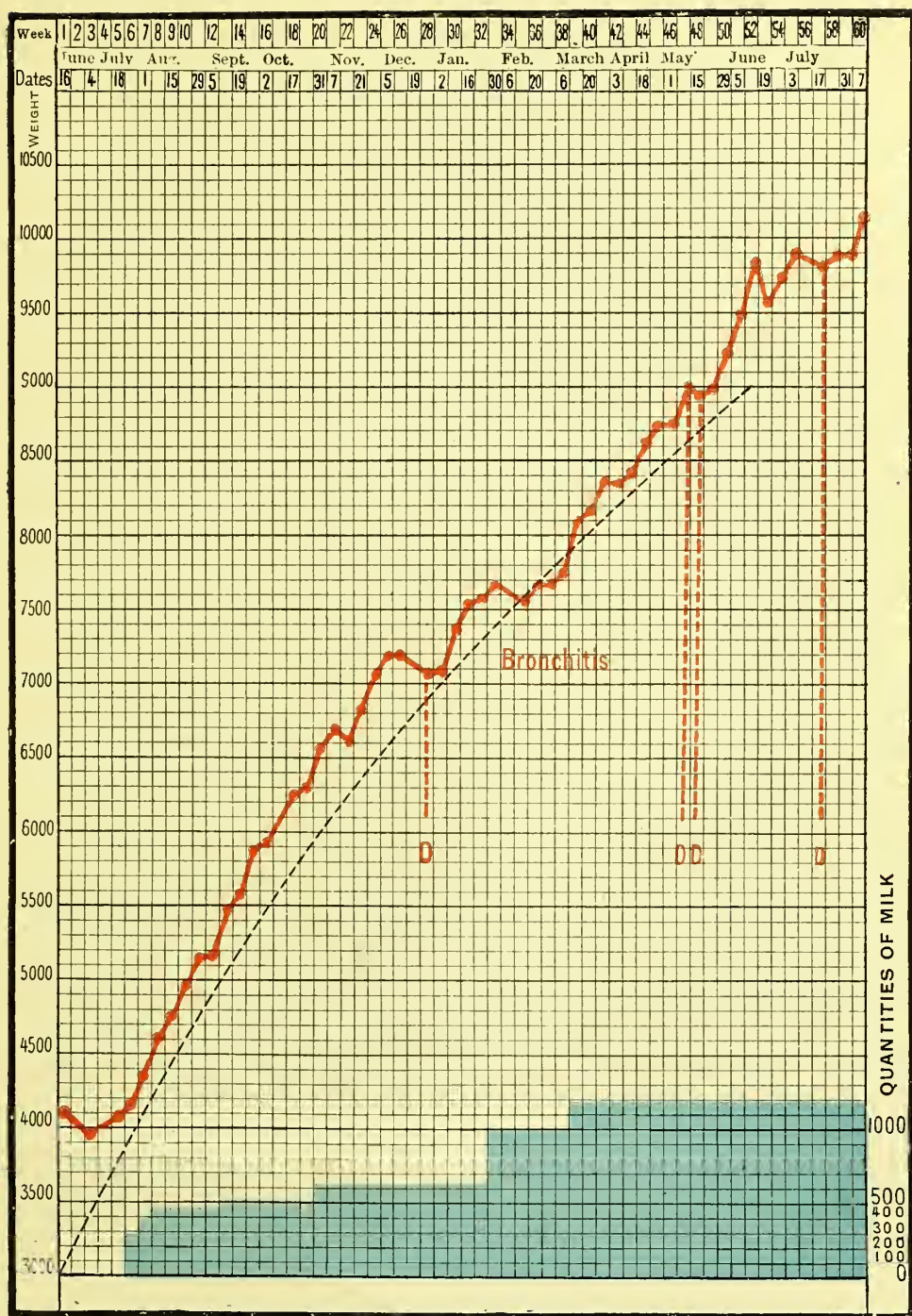


FIG. 115.—Feeding first mixed, then artificial. Curve shows the effect of teething on the weight. D, Evolution of a tooth.







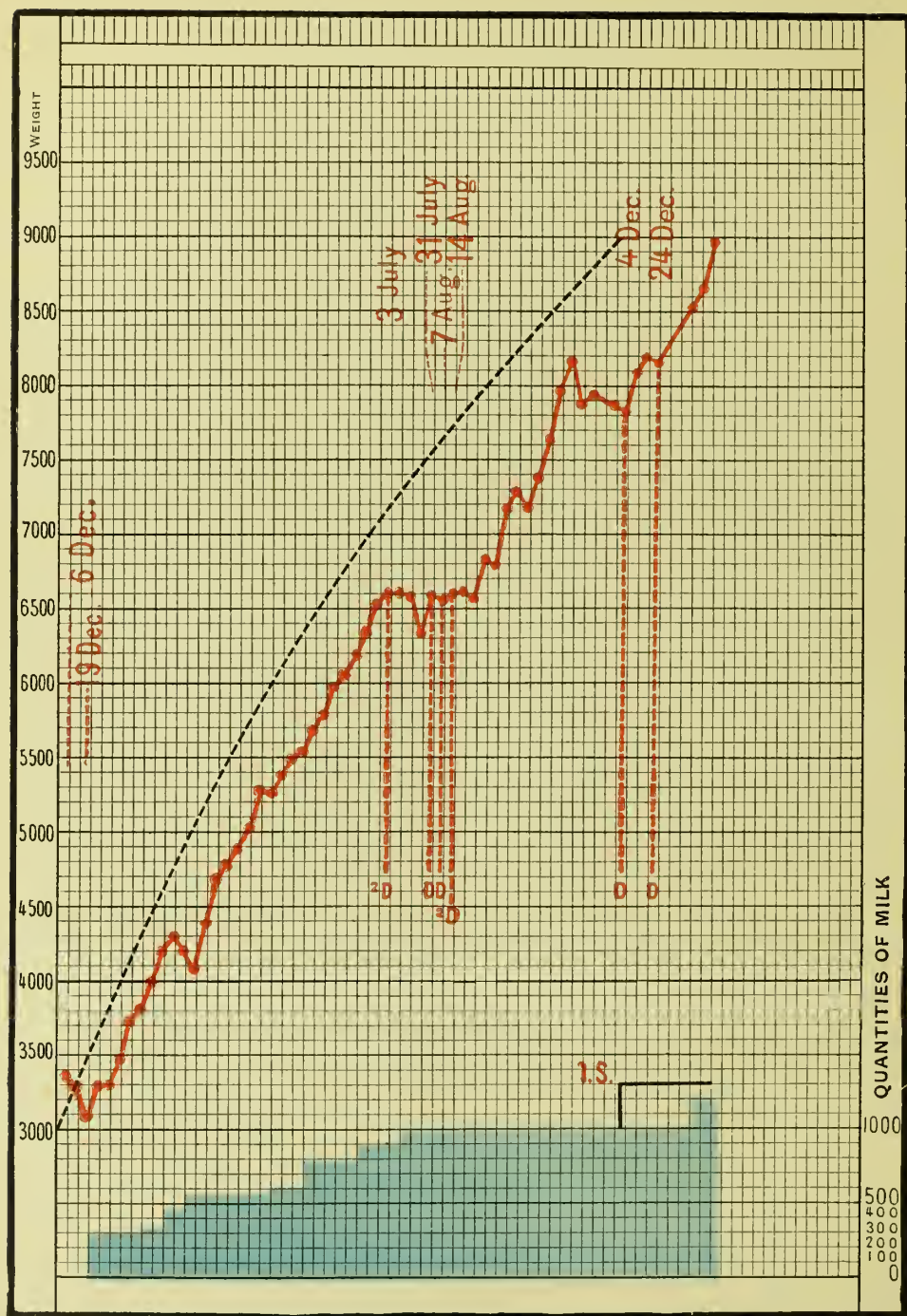


FIG. 116.—Feeding first mixed, then artificial. Showing the effect of the dental evolution on the infant's weight. D, Evolution of a tooth.

31, August 7, August 14 (2), December 4, and December 21, and the curve shows that at these periods the weight either remained stationary or diminished. The same phenomenon is observed on the curves of the infants Liver—— (Fig. 105, p. 135) and Go—— (Fig. 68, p. 95).

After a period which varies within wide limits, the mother's milk ceases to be sufficient for the infant's needs. Either its quality deteriorates or its amount diminishes. It is then necessary to substitute cows' milk or other foods, and this constitutes weaning.

Weaning is not always an easy matter. Some infants persistently refuse every other form of nourishment but the breast. Most of you remember the woman Dubois. She was an excellent nurse, and for a long time her little son throve to my entire satisfaction. But the mother gradually lost her milk, and, in spite of all we could do, the child absolutely refused to take anything but the breast. He soon ceased to grow, and, little by little, dwindled away till he was but a shadow of his former splendid self. I tried him with sterilised cows' milk, sweetened and unsweetened, "soups" made with milk, and other forms of nourishment too numerous to mention, but all without avail. Such infants soon waste considerably, and your ingenuity will often be severely taxed in trying to steer them through this difficult period of weaning.

Similar cases are not rare among infants suckled by their mothers, but they are much more common among those entrusted to wet-nurses. To a wet-nurse weaning may mark the termination of her engagement; it is, therefore, not to her financial interest to facilitate the process. Not unfrequently she pleads her inability to get the infant to take anything except the produce of her breasts, but her efforts require very little discouragement. She would soon devise some means of supplementing her inadequate supply if it were a question of her own child, but when it concerns only the nursling she is hired to suckle, her finer feelings become submerged in her business instincts.

On the other hand, weaning is an easy matter when an infant, besides the breast, has been accustomed to take one or two bottles of sterilised milk daily. All that is necessary is gradually to increase the number of bottles per day, and the child will be rapidly and safely weaned. Many mothers train their infants in this way from the beginning—some because they have not quite enough milk, others because they do not wish their night's rest interrupted; yet again others have duties which take them away, and sterilised milk

replaces breast-feeding during their absence. These mothers can wean their children very readily, as you will have occasion forcibly to realise if you leave them to their own discretion.

Infants are not fed exclusively on cows' milk after they are weaned: they are given also light "soups," prepared from milk and farinaceous substances, such as arrowroot, tapioca, racahout, rice, potatoes, wheat, oats, barley, &c. At first, the "soups" contain only a small quantity of feculent matter, which is very thoroughly cooked. Some practitioners do not employ them till after the first year, but I have often given them earlier. I have frequently heard doubts expressed as to the utility of these "soups," but I think it is easy to prove that they are often of the greatest nutritive value. They are made with a portion of the infant's daily allowance of milk, and on adding one "soup" to the dietary of a stationary infant, without in any way altering his quantity of milk, I have frequently seen his weight begin steadily to increase.

A woman named Mer—— was sent to me by the Superintendent of the Hôpital Cochin. She had weaned her newly-born infant, because she had to work for her living, and he asked me to grant her the daily milk required by the child. The feeding was therefore exclusively artificial. If you examine the curve (Fig. 117), you will see that on June 10 the infant was receiving 900 grams of milk and one "soup." On June 24 a second was given, and this sufficed, without any augmentation of the daily milk allowance, till November 18. Yet, in this interval the child having increased from 7100 to 9500 grams, had gained 2400 grams.

Another woman, called Fi——, was delivered on June 19, 1896, and when she returned from a convalescent home on July 25, she had no longer any milk. She was not one of my patients, but the Director of the Maternité, moved to compassion by the poor woman's extreme solicitude for her child, asked me to direct its feeding, and supply it with the necessary milk. At first I gave 400, then 600, and on January 23, 1897, 1000 grams of sterilised milk per day. On March 6 the first "soup" was ordered, and on April 24 another was added, yet till June 26 the quantity of milk remained unaltered. The infant had continued steadily to increase, owing to the influence of the few teaspoonfuls of flour made into "soups" with the milk (Fig. 118).

As a rule I do not allow broths, gravies, nor any other foods. I prescribe only milk or "pap" made with milk during the first two years. When they have completed twenty-four months they



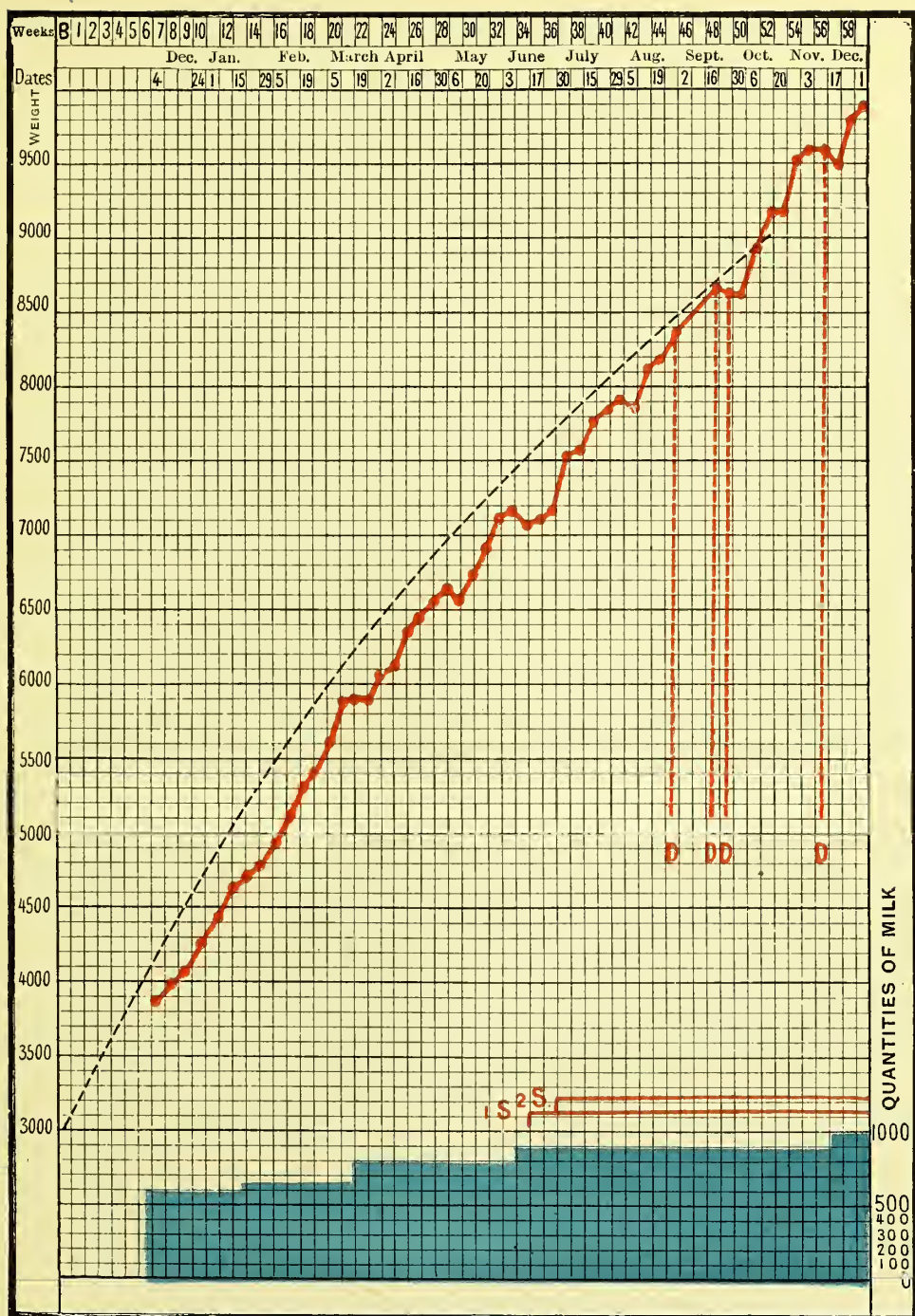


FIG. 117. Artificial feeding. Daily allowance of milk from the thirty-fourth to the fifty-seventh week was 500 grams. In this interval the weight rose from 7100 to 9000 grams, and the diet had been augmented by two "soups" only.









are discharged from the Consultation, but the greater number are brought back from time to time by their proud and grateful mothers for my inspection.

I have now outlined my methods of infant feeding. How have they been justified by results? This you may judge for yourselves, gentlemen, any day you care to visit our Consultation.

It has been said that infants reared on mixed, and especially on artificial feeding, are fat and flabby, and have very little resisting power to disease. They are alleged to be prone to all sorts of evils—abdominal enlargement, a special form of dyspepsia arising from the use of undiluted milk, rickets, eczema, scurvy-rickets, &c.

The tumid abdomen is almost unknown among my nurslings. I have met with it in only one case. The child in that instance was receiving  $2\frac{1}{2}$  litres of diluted milk per day, and on reducing his allowance to 900 grams, his abdomen regained its normal volume.

I am absolutely unacquainted with the so-called “undiluted milk dyspepsia.” We always inquire as to the colour of the infant’s stools, and the mother almost invariably replies that it is yellow. White stools of the consistency of putty, the pathognomonic sign of the new dyspepsia, indicate merely that the infant is being overfed. We never see them, for we do not overfeed; it is rarely that we need to prescribe more than 1000 to 1200 grams of milk even for infants in their second year.

As for rickets, not a single case has occurred in any of my Consultations since I first began in 1892. One was sent to me from the dispensary of one of my colleagues. You may remember I described it to you (p. 139); the poor little unfortunate was getting 2500 grams of fluid per day.

A distinguished doctor came from Budapesth not long ago in order to see my Consultation. He had been accustomed to believe all sorts of accusations against undiluted sterilised milk as an infant’s food. To convert him from error and remove his doubts I had all the children stripped, and then invited him to examine them. This he did with the greatest care, but to his profound surprise did not find a single child which presented even a trace of rickets.

Neither will you see eczema among our little patients. Since 1892 I have observed only two cases, both of which were suckled by mothers indulging to excess in food and drink. I have given

you my opinions on this subject in an earlier lecture (p. 93, Fig. 64). Our infants on mixed and artificial feeding are never affected with eczema, for they are not overfed, they are free from digestive troubles, and they are kept clean.

Tuberculosis we practically never see, for we distribute nothing but sterilised milk.

As for the so-called "infantile scurvy" which is alleged to follow the use of sterilised milk, I have heard a very great deal about it during the last few years, but I am still looking for my first case. What constitutes these "antiscorbutic properties" of fresh milk? I do not understand how sterilisation causes them to disappear.

Infants fed on animal milk are also alleged to be without strength and resistance, although heavy and fat. This has not been my experience. Mothers, from time to time, bring back my former little patients to see me, and I have always found that in general health and physique they would compare favourably with any children of their age.

In our next lecture, the last on the subject of infant feeding, I shall discuss in detail the organisation of Consultations for Nurslings and their results.



## LECTURE X

SUMMARY :—Creation of Consultations for Nurslings—The Consultation for Nurslings at the Clinique Tarnier—Breast-feeding—Mixed feeding—Artificial feeding—Statistics—Distribution of sterilised milk in bottles each containing enough for one meal only—Results obtained.

Mortality of infants under one year in Paris—Death-rate among those remaining in the capital—Death-rate among those sent to the provinces—Mortality among those who followed the Consultation—High death-rate from *cholera infantum* in Paris during summer 1898—Not a single death at the Consultation.

Other Consultations—Commercial sterilised milk—The movement in the provinces—The “Goutte de Lait” at Fécamp—Results.

Considerable mortality in the large towns of Seine-Inférieure, Rouen, Bolbec and Havre during summer 1898—Comparison with the statistics of the “Goutte de Lait” at Fécamp. Excellence of the results obtained in Crèches from attentive supervision of the infants and the use of sterilised milk.

Conclusion.

### GENTLEMEN,

In 1892 I was authorised to organise at the Charité the first Consultation for Nurslings.

I wish to devote to-day's lecture to the consideration of these Consultations and their results, so that you may realise what is being done to better the condition of infants during the difficulties and dangers of their early days.

Every week mothers who have been delivered in this Clinique bring their infants to the hospital to be examined and weighed. In a special register all information regarding the children, such as weight, teething, illness, &c., is recorded, and from these data the infants' curves are plotted.

I do my utmost to encourage breast-feeding, and where a mother's supply is not quite adequate for her infant's needs, I still utilise all the milk she is capable of furnishing, sometimes with the happy result of abundance developing out of insufficiency.

In cases where breast-feeding alone is manifestly impracticable, I prescribe a variable quantity of sterilised milk, which the mother obtains here every morning. Sometimes a mother has no milk at all, and then we are obliged to feed her infant exclusively on sterilised milk.

Each mother receives a pasteboard card, on which is written the

infant's number in the register, date of birth, weekly weight, mode of feeding, and daily allowance of milk (see Appendix).

When necessary an infant is brought more than once a week.

Many mothers, though ignorant and poor, are eager to fulfil their obligations to their children, and, instead of abandoning them to their own devices, is it not our duty to supervise, direct, and help them to the best of our ability? As one of my pupils has aptly said, "These Consultations are really schools for mothers, for in them not only do we tend the child, but we also instruct the mother, giving her directions for present and future guidance."

You must not infer that my task is always easy. Obedience is scarcely the distinguishing feature of women of the poorer classes. They are beset by the clamorous counsels of their well-meaning but ignorant neighbours, and many a time have they rendered my labour fruitless by supplementing the daily allowance I was giving to their infants, according to the standard laid down by the infallible busy-body who lived next door. Now, I limit my Consultations to those who leave my wards. They are already accustomed to be governed by my advice, and are educated to the value of weighing their children from daily observation of the process in hospital. If a nursling is ill, its mother keeps me informed as to its progress till the moment of its return to the Consultation.

Of the Consultations for Nurslings which I created at the Charité and at the Maternité, the former is now directed by Dr Maygrier, and the latter by Dr. Porak. That which I installed here, at the Clinique Tarnier, in 1898, comprised on June 2, 1899, 79 infants.

48 were breast-fed . . . . .	48
14, at first breast-fed, were then on mixed feeding, for their mothers had an insufficient supply of milk.	
4 had been on mixed feeding from the first.	
9, who had been breast-fed or on mixed feeding, were weaned, for we keep infants till the age of two years.	
This makes a total of 27 infants for whom had been utilised all the milk their mothers were capable of producing .	27
4 had been on artificial feeding from the first . . . .	4
	<hr/>
Total . . . .	79
	<hr/>

Very rarely does it happen that infants are reared from the beginning on artificial feeding, but these last four on their discharge

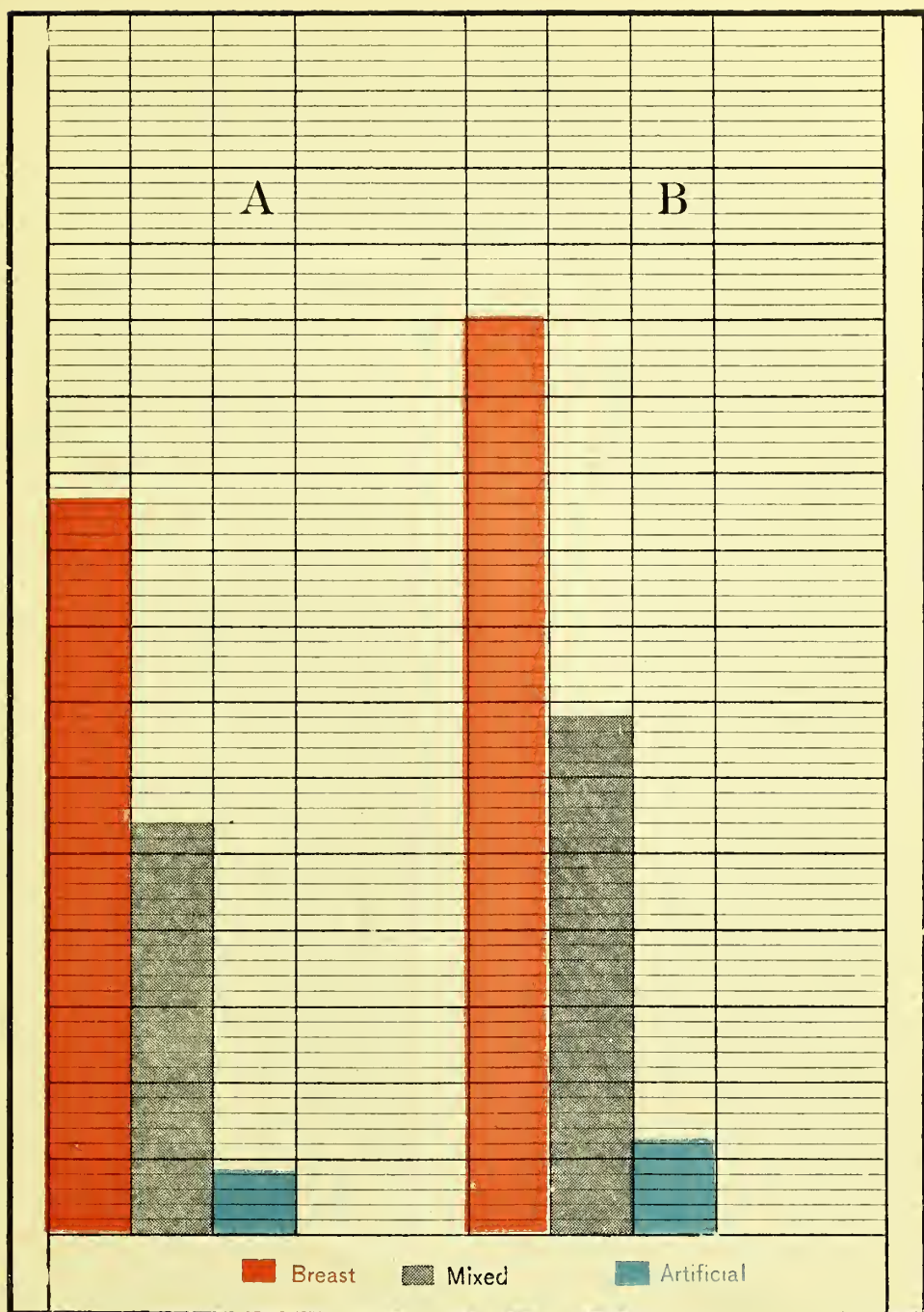


FIG. 119.—Consultation for Nurslings at Clinique Tarnier. A, Number of infants of the Consultation in 1899 who were reared on breast, mixed, and artificial feeding respectively. B, Percentage proportion of infants on these modes of feeding.



from hospital had been entrusted to wet-nurses, by whom they were grossly neglected. Their mothers, finding them in a sorry state, had brought them back to us. As these women had no longer any milk, we had no option but to rear their infants on sterilised milk.

At the beginning of June 1899, as is shown on Fig. 119—

60 per cent. of the infants attending my Consultation here were breast-fed.

34 per cent. were taking all the milk their mothers could yield.

6 per cent. were artificially fed.

Breast-feeding is our special aim. Those who feed their infants exclusively at the breast are required to attend only once a fortnight, if all is going well, while the others must present themselves regularly every week.

When I first began, mothers who were suckling, seeing how well their infants thrived, ceased after a time to attend the Consultation. Only those whose infants, being on mixed or artificial feeding, were receiving sterilised milk, continued to patronise me for any length of time. But, nowadays, mothers are beginning to appreciate the benefits of medical supervision, and many who give their children nothing but the breast now attend with unfailing regularity.

The cows' milk which we distribute is contained in small sterile bottles. As in each there is enough for only one meal, overfeeding is avoided. The contents of any bottle, once uncorked, must be used immediately or discarded.

Each litre of milk we receive costs the public authorities 20 to 25 centimes. The expense of sterilisation and of distribution raises its price almost to 35. Our daily output being from 18 to 20 litres, we spend annually about 2500 francs.<sup>1</sup> With this comparatively small sum I conduct a Consultation numbering 79 infants.

What results have been obtained? What has been the general health of the infants? How has their mortality been affected?

As regards general health, I told you in last lecture that our nurslings enjoyed complete immunity from rickets, infantile scurvy, and the dyspepsia alleged to arise from the use of pure milk. Since 1892 I have had two cases of eczema in nurslings; both were exclusively breast-fed, and the eczema disappeared when the mothers were properly dieted.

As regards mortality, in conjunction with Dr. Chavane, who has always taken an active interest in this work, I have published several series of results. Before discussing my figures let us first see, for

<sup>1</sup> About one hundred pounds sterling.



the sake of comparison, what is the general mortality among nurslings.

The infantile mortality used to be terrible. At Reims the death-rate among infants under one year was 56.31 per cent. in 1886; and in a single district of Lille it reached the appalling figure of 89 per cent. in 1880. Since the introduction of the "Roussel Law" a great diminution has happily taken place, but the death-rate among nurslings is still considerable. Lédé made a minute and precise investigation of the infantile mortality in Paris for 1885, and found that it was 27.52 per cent. Out of 13,830 infants born, only 10,161 survived, nearly 3700 died.

Bertillon found the death-rate for the four years 1886 to 1890 to be 21 per cent. among infants dwelling in Paris, excluding those under the care of wet-nurses.

In the rich central parts of the capital the number of deaths is less than in the poor peripheral districts, so that, if the infantile mortality was represented on a plan of Paris by shades which darkened as the number of deaths increased, the city would be encircled by the deepest mourning.

Infants sent from Paris to wet-nurses in the provinces must be considered in two categories—those who are bottle-fed and those who are breast-fed.

The nearer the province is to Paris, as a rule, the lower is the mortality, for the nurses are under stricter supervision around the capital than in other parts of the country. Yet in the adjacent department of Seine-et-Oise the death-rate for the first category is 28.21 per cent., while in the more remote province of Pas-de-Calais it is almost 40 per cent.

Among those breast-fed, or considered as such, the mortality is 14.54 in Seine-et-Oise, and 28.57 per cent. in Pas-de-Calais. But these figures are not quite reliable, for many self-styled breast wet-nurses, having no milk, practise artificial feeding, so the mortality in the second category is increased at the expense of that in the first.

In Paris there were 59,112 births and 7089 deaths under one year, in 1898, which makes a mortality of 12 per cent. among infants who, not having left the capital, were nearly all under their parents' care.

From January 1, 1896, to November 14, 1897, the total mortality among infants sent to the provinces was 47 per cent.; out of 32,544 infants 15,295 succumbed.

From 1892, when I instituted my first Consultation, till June 1899, counting only those infants who have been under my care for at least one month, or at most two years, I have had altogether 435 nurslings.

238 were exclusively breast-fed, and 197 were on mixed or artificial feeding.

Out of these 435, 32 have died, which makes a general mortality of 7.3 per cent. The following were the causes of death:—

Broncho-pneumonia (5 following measles, and 1 whooping cough) . . . . .	10
Pulmonary tuberculosis . . . . .	1
Meningitis . . . . .	7
Suppurating glands in the neck . . . . .	1
Subacute peritonitis . . . . .	1
Diphtheria . . . . .	1
Congenital syphilis . . . . .	3
Small-pox (one of the hæmorrhagic type). . . . .	2
Infantile cholera . . . . .	1
Convulsions without further specification from the practitioner in attendance: disease lasted only a few hours: diagnosis uncertain . . . . .	5
Total . . . . .	<hr/> 32 <hr/>

The case of infantile cholera was that of an infant S—No. 881. He had several attacks of diarrhœa, and I discovered that the mother, while she went to work, left him in a day nursery where he was getting impure milk. In spite of my warning she placed him there again on April 24, 1897. Diarrhœa began that night, and next day the child was dead.

This had almost the value of an experiment, for it is the only case of fatal diarrhœa I have had in my Consultations since I started in 1892.

In the general infantile mortality there is a death-rate of special interest to us, viz. that arising from gastro-enteritis. This disease rages especially during the height of summer, and affects mainly bottle-fed babies, for, under the influence of the elevated temperature, organisms develop rapidly and abundantly in cows' milk, till it becomes little more than a toxic fluid.

In this curve (Fig. 120), due to Malmejac, representing the

mortality from diarrhoea in the Seine Department during the year 1896, July is seen to be the most fatal month.

During July 1898 diarrhoea caused 53 per cent. of all the deaths among nurslings. Ten per cent. were fed at the breast, and 43 per cent. from the bottle (see Appendix). During the intense heat which prevailed in the summer of 1898, I contrasted the condition of affairs in Paris with that at our Consultation. On Fig. 121 I have represented the weekly mortality from diarrhoea, during 1898, among infants under one year; below is found the death-rate among breast-fed infants; above, that among bottle-fed. The superposition of the two curves would give the total mortality from diarrhoea which, in order to simplify the figure, has not been indicated.

The mortality from August 7 to September 3 was frightful; in four weeks 833 infants perished from diarrhoea. From August 14 to August 27, 550 of these deaths occurred, of which 493 were among bottle-fed infants. On the curve this sudden increase in the death-rate recalls the appearance of the Eiffel Tower.

What was happening here, at the Clinique Tarnier, during this time? Dr. Chavane made a careful abstract of all the nurslings who followed the Consultation during June, July, August, and September 1898.

There were 53 infants then regularly attending. Of these 19 were breast-fed and 34 bottle-fed. Digestive troubles arose in 12; in 9 the attacks were slight, in 3 they were serious. The morbidity from alimentary causes was consequently 22 per cent.

As there were no deaths our mortality was zero.

Below the towering columns, which indicate the mortality from diarrhoea among infants in Paris during these four months, is a horizontal line, corresponding to zero, which represents the death-rate at our Consultation. (For the year 1899 see Appendix).

Since I instituted the first Consultation for Nurslings in 1892 many others have been organised. That which Dr. Variot inaugurated at his dispensary in 1893, has given excellent results, and rendered inestimable service to the poor of Belleville. My former pupil, Dr. Henri de Rothschild, in March 1896 founded a Consultation at his dispensary; the same experiment has been made by Dr. Dubrisay, and also, at the Hôpital Tenon, by Dr. Boissard, who was my assistant at the Maternité.

On the initiative of M. Paul Strauss the General Council of the Seine have organised Consultations at their dispensaries in Paris and the neighbourhood.



FIG. 120.—Monthly mortality from diarrhoea among infants breast-fed and bottle-fed during the year 1896 (Malméjac).





Under the direction of my colleague, Dr. Napias, three others were opened in March 1899, and I am convinced that his untiring energy and boundless enthusiasm will tend greatly to further the movement.

Organisations for helping nursing mothers would materially add to their utility by including Consultations in the scope of their work. Each week a doctor could weigh and examine the infants, advise the mothers, and distribute, when necessary, bottles of sterilised milk of good quality. In this simple manner the great dangers of impure milk, overfeeding, and premature weaning would be avoided. A great stimulus, also, would be given to breast-feeding, for mothers, in receipt of monetary aid, might receive the full grant only if their breast sufficed to nourish their infant, and, if sterilised milk was necessary, the cost might be deducted from the mother's subsidy. This would prove a substantial encouragement to suckling, and would ensure that at least part of the money expended would go to benefit the child.

Some dispensaries give milk which they sterilise in small bottles ; while others distribute the sterilised milk of commerce. Dr. Variot strongly recommends this. At his Consultation the majority of infants are already weaned before they come under his care. To sterilise milk in small bottles at his dispensary would be, he thinks, a complicated and costly operation, and he considers it simpler and cheaper to distribute it in large bottles. He guards against overfeeding by giving to each mother a small, graduated vessel, on which is indicated the maximum quantity of milk to be taken at any given age.

Variot and Marfan fear that milk sterilised in small bottles at hospitals and dispensaries contains toxins injurious to infants. They insist upon the importance of sterilising milk as soon as it is drawn, and laud the commercial product, which, they believe, is heated to  $110^{\circ}$  C. at once on its collection, as it should be, but, unfortunately, as it rarely is.

At the beginning I had the same fears, but the milk I use at the hospital is pasteurised to preserve it during transit, and is sterilised on arrival. I have never seen any manifestations of these alleged toxins, and it is probable that, if ever formed, they are, like most other toxins, destroyed by the subsequent sterilisation at  $100^{\circ}$  C.

I continue, therefore, to use milk which I sterilise in the hospital. It does not cost more than that commercially sterilised,

and I am certain of its age. The industrial product is not stamped with the date of preparation, and is sometimes a very ancient fluid. Each of our small bottles is immediately used ; none are exposed to the danger of contamination from repeated withdrawals of small amounts ; and as each contains enough for only one meal, there is never any risk of overfeeding.

All through the provinces Consultations are being organised.

In 1893, the Municipality of Dieppe unanimously voted the sum of 2000 francs for the creation of a Consultation for Nurslings.

In July 1894 Dr. Berlioz obtained a grant from the local authorities, for the distribution of sterilised milk during summer, to the infants of the poor at Grenoble. The excellent results he had obtained I communicated to the *Academie de Medecine* in 1897.<sup>1</sup>

The pioneer in the provinces was Dr. Dufour of Fécamp. In July 1894, without any knowledge of my work in Paris, he instituted a Consultation for Nurslings under the happy and picturesque title of "Goutte de Lait." "The sphere of the 'Goutte de Lait,' " writes M. Dufour, "is to give to mothers all possible advice and encouragement in the suckling of their children.

"As often as the maternal supply is inadequate and demands an artificial supplement we provide the requisite amount of milk, and the infant is reared on mixed feeding.

"When it is proved to be a physical or social impossibility for a mother to suckle, the Consultation takes the responsibility of preparing the milk destined for the infant, so as to ensure its quality and purity.

"All infants in the town of Fécamp are admitted to the benefits of the Consultation. They are separated into three categories : 1. A gratuitous section. 2. A partial-paying section. 3. A paying section. The first comprises infants of the poorer classes ; the second, those of the artisan class ; and the third, those of the middle and upper classes. All, however, receive the same milk, prepared and distributed in the same manner."

Dr. Dufour does not give undiluted cows' milk to infants. He believes in modifying it so as to approximate the composition to that of human milk. He dilutes it with one-third of its bulk of water, and to each litre of this mixture adds 15 to 20 grams of fresh cream, 35 grams of lactose, and 1 gram of sodium chloride.

The milk thus modified is measured into small bottles, each of which contains the equivalent of one meal, and, after being sterilised

<sup>1</sup> *Bulletin de l'Academie de Medecine*, Paris, 1897.

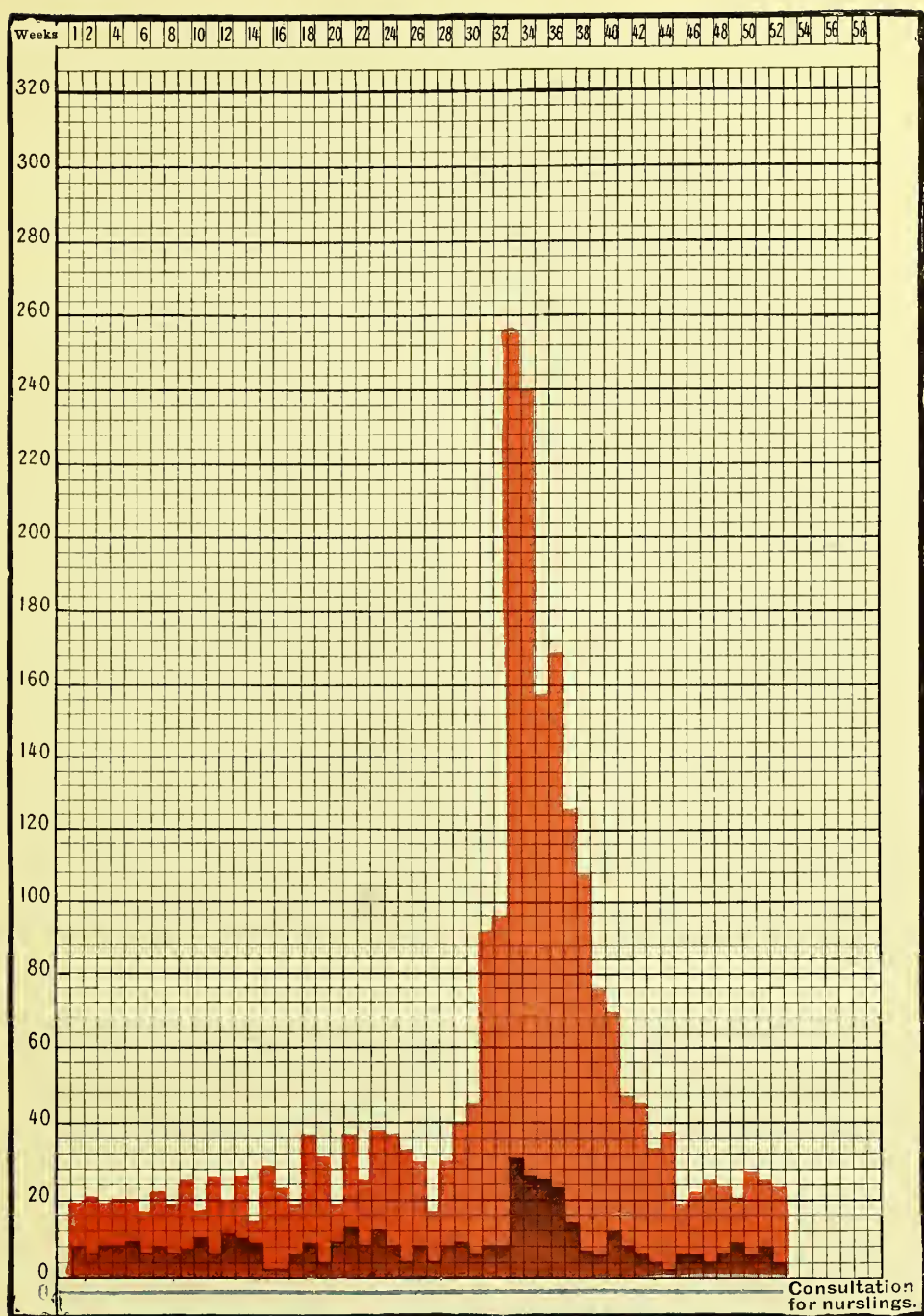


FIG. 121.—Death-rate from diarrhoea among infants under one year of age in Paris during the year 1898. Black=breast-fed; red=bottle-fed. The horizontal blue line at zero shows that the mortality was nil at the Consultation in 1898.



at 102° C. for three-quarters of an hour, it is ready for distribution. Great care is taken to avoid overfeeding. He thus expresses himself with regard to his results:—

“Further, from the rigour with which they are dieted these infants derive an increased resistance to disease. I can verify Dr. Budin’s assertions on this point from my own experience. My little clients, whether breast or bottle-fed, never being gorged with food, have neither eczema nor tumid abdomens; these are things unknown at the dispensary of the ‘Goutte de Lait.’

“Although employing ‘humanised’ milk I never have a single case of rickets, and yet I rarely give quantities greater than 1200 grams per day.

“As the milk is heated for three-quarters of an hour to between 100° and 102° C., all possibility of tuberculosis is excluded.

“Our milk, freshly drawn, ‘humanised’ and sterilised at the dispensary, is consumed within twenty-four hours, and although I have now been conducting this work for five years I have yet to see my first case of infantile scurvy.”

Dufour’s statistics are extremely interesting, for he has been able to compare the figures obtained at his dispensary with those from the town of Fécamp. The following table is a synopsis of his results:—

Years.	The “Goutte de Lait.”		Town of Fécamp.	
	Number of Infants.	Mortality from Diarrhœa (per cent.)	Number of Births.	Mortality from Diarrhœa (per cent.)
1894-1895 . . .	33	0	400	6.80
1895-1896 . . .	73	6.80	429	18.18
1896-1897 . . .	68	3.97	420	9.51
1897-1898 . . .	125	2.26	455	12.00
1898-1899 . . .	156	1.28	434	9.67

The mortality from gastro-enteritis has been steadily diminishing at the Consultation since 1895. The year 1894-95 can scarcely be taken into account, for the Consultation was not begun till July, and, as very few of the 33 infants were members during the deadly summer months, the death-rate of zero has but little significance.

The difference between the mortality from diarrhœa in the town



and in the Consultation is made more evident by the accompanying tracing (Fig. 122).

The increasing popularity of the Consultation is also noteworthy. The attendance rose from 33 in 1894 to 156 in 1898. Out of 434 born in Fécamp from July 1, 1898, to July 1, 1899, 156, that is more than one-third, became members of the Consultation, and of these a certain number belonged to the paying section.

In order to emphasise the results he obtained during the fatal summer of 1898, Dufour collected statistics from the principal towns of Seine Inferieure. He noted the number of deaths under one year from diarrhœa during the month of August, and contrasting this with the number of births, showed the loss sustained by society:—

Town.	Mortality from Diarrhœa.
Rouen . . . . .	76.6 per cent.
Bolbec . . . . .	66.0 „
Havre . . . . .	51.2 „
Fécamp . . . . .	16.0 „

At the “Goutte de Lait,” although the mortality from diarrhœa was calculated not for infants from zero to one year, but from zero to two years, and not for the month of August alone, but for the three months, July, August, and September, it was yet only 2.8 per cent. (Fig. 123). The eloquence of results such as these, gentlemen, raises Dr. Dufour's work above criticism.

Many towns in France and in other countries have now Consultations for Nurslings; their number is rapidly increasing, and the movement is taking a comprehensive grasp of the leading civilised communities.

In many Consultations, unfortunately, artificial feeding is the rule. In some dispensaries in Paris it is almost exclusively practised, for mothers bring their infants only after they have weaned them. Personally, I am much more favourably situated. The authorities limit my Consultation to infants born in the Clinique. Every woman I deliver must suckle while in hospital. On a chart at the head of her bed she notes with interest the curve, which represents from day to day the progress of her infant's weight. When she leaves the Clinique she is usually both willing and able to nurse. We do our utmost to encourage her to persevere, and we find, from year to year, that maternal feeding is steadily increasing among our patients. To utilise all the milk a mother can furnish, to advise her in rearing her child, to help her with

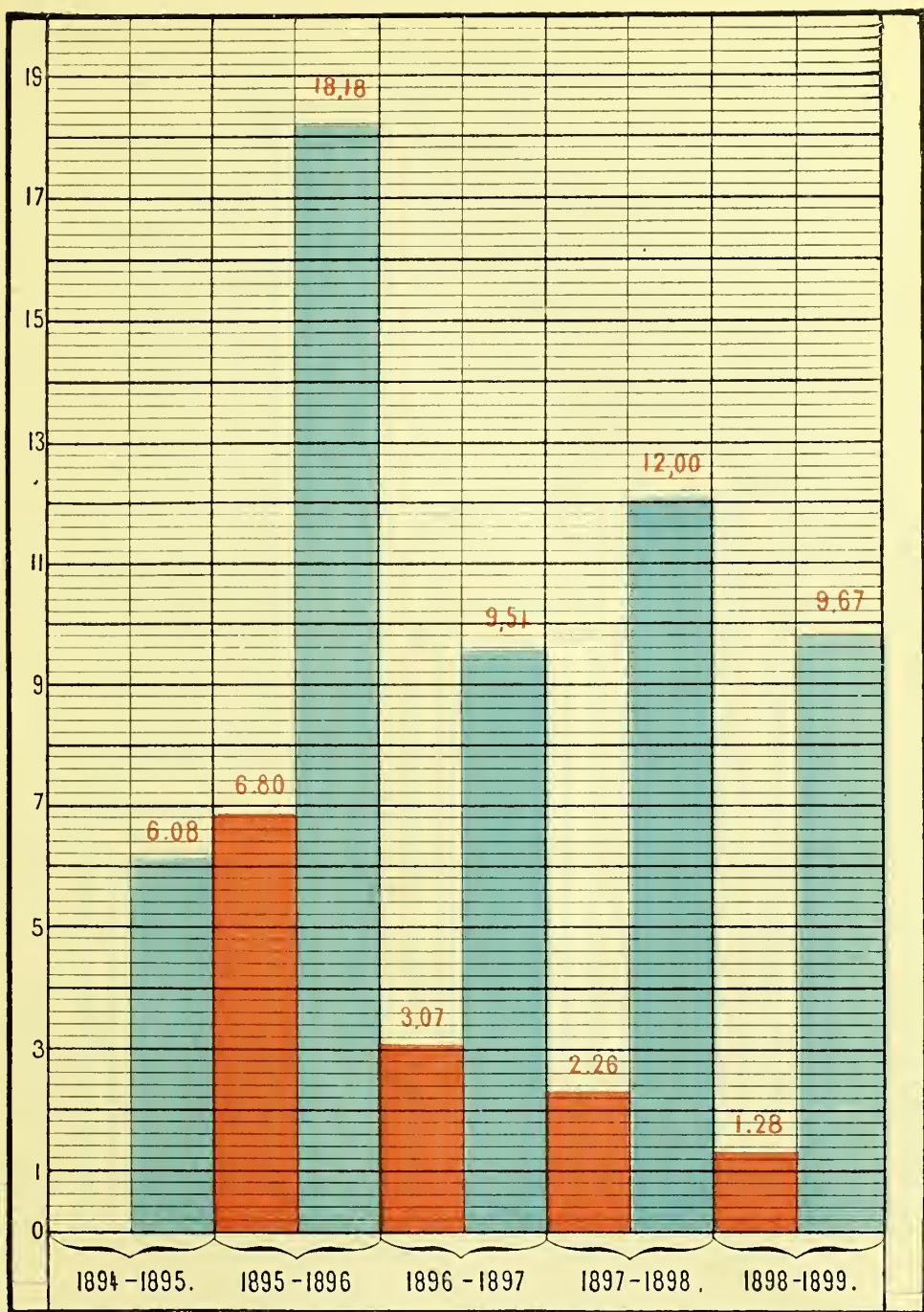


FIG. 122.—Mortality from enteritis in the town of Fécamp and at the "Goutte de lait" (Dufour). The blue columns indicate the mortality in Fécamp, the red the mortality at the "Goutte de lait."





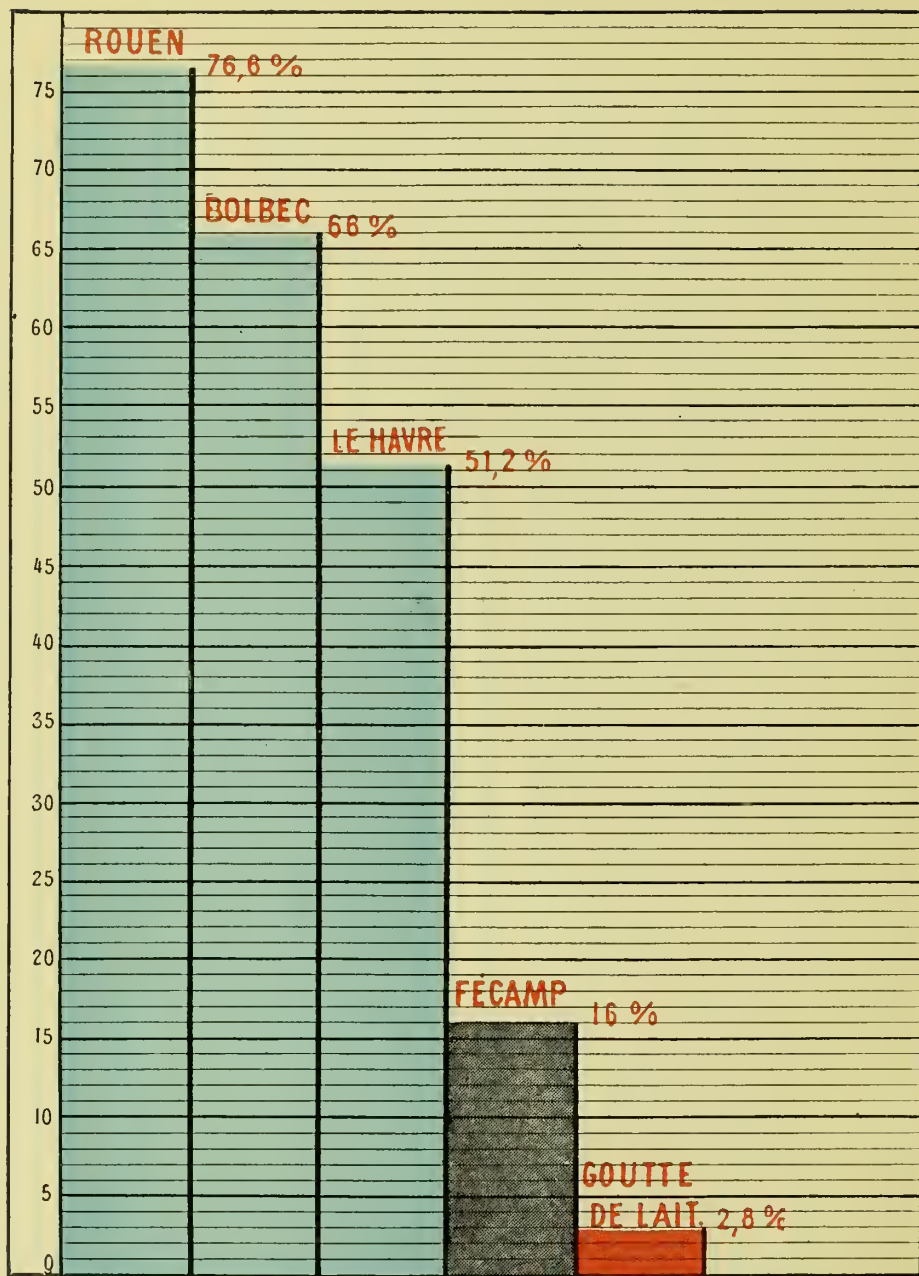


FIG. 123.—Mortality from enteritis among infants under one year of age in the principal towns of Normandy and at the "Goutte de lait" during August 1898 (Dufour).



sterilised milk when her mammary secretion does not suffice for her infant's needs, are our aims in instituting Consultations for Nurslings, and a little patience and perseverance will realise their fulfilment.

The use of sterilised milk and the careful supervision of infant feeding has greatly enhanced the value of crèches.

Dr. Drapier, who conducts a large crèche at Réthel, consulted me regarding the feeding of his little charges. In his published results he writes :—

“In 1893 the death-rate from infantile cholera was 13 per cent. I was then using ordinary milk.

“In 1894 I adopted the recommendations of Dr. Budin, and it at once fell to 5 per cent.

“In 1895 it was further reduced to 3 per cent.”

If an abstract of the returns for June, July, August, and September of the fatal year 1898 be made for the four crèches in Paris in which sterilised milk is used, under proper supervision, the following table is obtained :—

Crèche.	Under the Care of	Total of Infants.	Simple Enteritis.	Choleraic Diarrhœa.	Deaths.
Furtado Heine . .	Dr. Laborde . .	140	32	1	0
Rue Gauthey . .	Dr. Gauchas . .	24	4	0	0
Sainte Philomène .	Dr. Belluze . .	74	2	0	0
Fénelon, Charles .	Dr. Bouquet . .	44	0	2	0
Total . . . .		282	38	3	0

For the 282 infants observed in these four crèches, the total morbidity was 14.5 per cent., and that from choleric diarrhœa was 1 per cent.

The mortality was zero.

Compare this with the appalling death-rate in Paris during the same period (Fig. 121).

In a lecture which I was asked to give to the Artisan Congress on April 22, 1892, I said: “During the last few years I have been privileged to assist in what has been little short of a revolution. Formerly a deadly affection, puerperal fever, terrorised our maternities. To-day, thanks to the progress which has followed the footsteps of Pasteur, women are delivered in safety. In properly conducted maternity hospitals death has now no place, and the

results obtained are better in these institutions than at the bedsides of the rich.

“Let us hope that we are on the verge of a similar revolution in the interests of the infant. Recent work, again the outcome of Pasteur’s labour, has shown that by means of sterilisation of milk, a process which each can carry out in his own home, a considerable reduction in the appalling infantile mortality is not only possible but practicable. By its use every one, poor and rich, can safeguard their little ones, and taste the sweet joys of family life without the heartrending sorrows. Your country has need of all her children, and humanity demands that we should spare no effort on their behalf.”

Gentlemen, Consultations for Nurslings and “Gouttes de Lait” are the instruments from which I look to see the realisation of these hopes of mine. By giving counsel to mothers in the rearing of their children, and by the use of sterilised milk under proper supervision, this revolution may be accomplished. If you are convinced of the value of the principles I advocate—and you can hardly be otherwise in the presence of the curves I have shown you, and of the weekly demonstrations you have had of the results obtained at the Consultation here—you will not, I think, remain indifferent. When you see nurslings dying around you, and feel powerless to save them—who knows? perhaps among them may be those very near and dear to you—you will then be roused to action, you will become disciples of the principles I preach, and you will protect your little charges from the terrible scourge of diarrhœa.

Then, why wait? Be guided by one who has already been chastened by this sad experience. Begin with your first cases. Counsel and encourage breast-feeding with all your strength, carefully supervise and direct mixed and artificial feeding, and use sterilised milk.

Whether your lot be placed in town or village, organise Consultations for Nurslings.

Strive always to fulfil your function as medical men, that glorious function which consists in consecrating your intelligence and your strength to saving the lives of your fellow-beings.

## APPENDIX

## APPENDIX I

CLINIQUE TARNIER, 1898.—*Statistics of Weaklings.*

Date.	Number of Confinement on Register.	Parity.	Weight at Birth.	Minimum Weight.	Weight on Departure.	Date of Departure.	Infants Dead.	REMARKS.	
								Mothers.	Infants.
Mar. 1	315	I	2500	2350	2500	Mar. 9	...	.....	.....
2	316	I	2410	2350	2700	10	...	.....	.....
6	332	II	2470	2400	2520	15	...	.....	.....
8	336	I	1940	1900	2130	26	...	Albuminuria.	.....
9	340	I	2250	2050	2200	27	...	.....	Bronchitis cured.
10	352	I	1260	1130	1130	12	+	.....	.....
14	376	I	2500	2440	2745	24	+	Albumin. Hæm. infarcts.	.....
16	378	I	1830	1575	1630	28	+	" "	Cyanosis.
16	378	I	1630	1380	1380	April 4	+	" "	Twins.
19	388	II	2450	2200	2320	Mar. 27	...	.....	.....
19	391	VII	2150	2095	2240	29	+	" "	.....
21	404	I	2450	2150	2150	25	+	.....	.....
22	410	I	2100	1800	1860	April 3	...	Album. Threatened eclampsia.	Cyanosis.
25	420	III	2120	1715	1800	6	...	Placenta large, oedematous.	Thrush.
26	423	II	2240	1980	1980	Mar. 31	+	Hydrannios.	Icterus.
28	432	I	1910	1590	1715	April 1	+	.....	Syphilis.
31	449	II	2240	2050	2125	10	...	Pulmonary tuberculosis.	.....
April 2	458	I	2230	1880	2285	April 7	+	Albuminuria.	Syph., broncho-pneum.
3	466	III	2350	2175	2200	11	...	"	.....
6	477	I	2370	2150	2370	14	...	.....	.....
7	480	I	2430	2175	2270	15	...	.....	.....
9	488	II	2230	2115	2175	23	...	.....	.....
13	512	IV	2100	1900	2075	19	+	Syphilis.	Icterus. Second twin.
20	574	II	1950	1770	1870	May 5	...	Lead poisoning in father.	Syph., broncho-pneum.
26	576	VIII	2250	2125	2250	4	...	.....	Hare lip, simple.
26	580	III	2220	2000	2025	8	...	.....	.....
30	593	I	2400	2160	2380	10	...	.....	.....
May 1	599	I	2300	2135	2400	May 11	...	.....	.....
7	630	I	2300	2170	2260	18	...	.....	.....
9	634	I	2000	1890	2300	31	...	.....	.....
10	640	I	2150	2075	2260	19	...	Albuminuria.	.....
11	642	IV	2290	2150	2410	24	...	Induction of labour.	.....

12	651	III	2470	2310	2375	21	...	Albuminuria.	Syphilis.	.....
14	658	II	2320	1925	2020	25	+	Hydræmiosis.	Syphilis.	.....
15	662	I	1600	1620	2055	June 14	...	.....	.....	.....
16	673	I	1900	1840	2000	May 29	...	Albuminuria.	.....	.....
17	676	I	2180	2020	2500	June 7	...	.....	.....	.....
18	687	I	2120	2060	2270	May 30	...	Eclampsia.	.....	.....
19	689	I	1970	1900	2400	June 14	...	Eclampsia.	.....	.....
21	699	IV	1880	1780	1975	May 3	...	Twins.	.....	.....
23	709	VI	2150	1820	2110	June 14	...	Albuminuria.	.....	.....
30	732	II	2150	2000	2590	June 28	...	.....	.....	.....
30	740	II	2130	2000	2420	14	...	.....	.....	.....
31	748	II	2260	1930	2300	21	...	.....	.....	.....
June 2	759	I	2000	1800	2900	June 27	...	Albuminuria.	.....	.....
2	761	I	1900	1750	2200	23	...	Pernicious anæmia.	.....	.....
2	765	VI	2200	2120	2380	20	...	.....	.....	.....
2	765	VI	1600	1450	1550	15	+	Twins.	.....	.....
11	800	VI	1970	1900	1945	19	...	.....	.....	.....
12	804	III	2500	2375	2600	25	...	Albuminuria.	.....	.....
13	808	I	1950	1875	2150	27	...	.....	.....	.....
14	810	I	2450	2250	2575	23	...	.....	.....	.....
14	816	II	2260	2100	2440	23	...	.....	.....	.....
15	816	IV	2470	2400	2800	26	...	Phthisis.	.....	.....
15	817	I	2290	2150	2475	28	...	Twins.	.....	.....
15	817	I	2430	2340	2500	28	...	Albumin.	.....	.....
18	833	I	2290	2240	2535	28	...	Albuminuria.	.....	.....
19	844	II	2400	2215	2375	29	...	.....	.....	.....
22	859	II	2480	2280	2280	26	+	.....	.....	.....
24	866	III	2350	1970	2325	14	...	Syphilis.	.....	.....
24	868	VII	2370	2000	2120	12	...	Bronze disease.	.....	.....
25	876	III	2270	2120	2330	12	...	.....	.....	.....
25	878	I	2450	2120	2500	13	...	Cyanosis.	.....	.....
July 1	904	I	1950	1730	1325	July 14	...	.....	.....	.....
1	906	III	2400	2050	2200	18	...	Phthisis.	.....	.....
6	933	I	1860	1550	1685	25	...	.....	.....	.....
6	937	II	2450	2275	2400	19	...	Version.	.....	.....
11	967	I	1610	1600	1850	24	...	.....	.....	.....
13	979	I	2200	1900	2150	27	...	Albuminuria.	.....	.....
13	980	IV	2210	2100	2250	26	...	.....	.....	.....
13	984	II	2110	1900	2100	28	...	.....	.....	.....
14	986	I	2250	2175	2225	26	...	.....	.....	.....
15	988	VII	2450	2025	2075	28	...	.....	.....	.....
Fractured femur.										



Date.	Number of Confinement on Register.	Parity.	Weight at Birth.	Minimum Weight.	Weight on Departure.	Date of Departure.	Infants Dead.	REMARKS.	
								Mothers.	Infants.
July 17	1006	I	2200	2025	2050	July 21	+	.....	Spina-bifida, malformations. .....
18	1009	I	2290	2125	2450	31	...	.....	
23	1032	I	1800	1650	2100	Aug. 23	...	Version.	
27	1056	I	1820	1725	2660	Sept. 6	...	Twins.	
27	1056	I	1590	1500	2030	6	...	.....	
28	1060	I	2450	2300	2600	Aug. 6	...	.....	
29	1071	VI	1950	1900	2075	16	...	.....	
Aug. 2	1094	I	2330	2180	2350	Aug. 14	...	.....	
4	1103	V	2460	2375	2475	11	...	.....	
6	1109	I	2450	2175	2350	16	...	.....	
7	1118	I	2180	2020	2170	16	...	Albuminuria.	.....
7	1119	I	2250	2120	2350	18	...	Twins.	
7	1120	IV	2410	2075	2250	18	...	.....	
9	1133	I	1680	1600	1930	24	...	.....	
11	1140	I	2500	2350	2750	21	...	Albuminuria.	
11	1145	I	1400	1250	1250	14	...	”	
17	1171	II	2470	2280	2310	25	...	.....	
29	1230	I	2390	2180	2280	Sept. 6	...	.....	
30	1231	I	2310	2120	2200	7	...	.....	
30	1239	III	2500	2250	2280	10	...	”	
Sept. 3	1256	I	2425	2120	2250	Sept. 14	...	”	.....
5	1266	I	2490	2250	2260	15	...	.....	
6	1274	II	2050	1980	2200	Oct. 6	...	.....	
7	1282	V	1500	1260	1290	Sept. 25	...	Twins.	
8	1284	I	1900	1650	1670	17	...	.....	
8	1285	II	1950	1830	1980	17	+	.....	
9	1293	I	2260	2175	2380	18	...	.....	
9	1297	II	2175	2010	2100	18	...	.....	
12	1305	II	2460	2300	2800	24	...	Albuminuria.	
13	1311	I	2220	2150	2300	22	...	.....	
13	1312	II	1900	1820	2150	26	...	Twins.	Thrush. .....
13	1312	II	2360	2220	2475	26	...	.....	
17	1327	II	2225	2075	2300	26	...	.....	
20	1337	I	2400	2275	2650	Oct. 1	...	.....	
25	1362	VII	2220	2100	2260	8	...	.....	
28	1373	IV	2400	2320	2540	10	...	Placenta previa. Eclampsia.	

28	1375	I	2500	2350	2610	8	...	.....	.....
29	1376	III	2370	2225	2575	8	...	.....	.....
29	1377	I	2500	2310	2575	11	...	.....	.....
29	1378	I	2250	2170	2300	11	...	.....	.....
29	1379	I	1750	1620	1800	13	...	.....	.....
Oct. 3	1389	V	2250	2150	2400	Oct. 12	...	.....	.....
6	1402	I	2400	2200	2350	15	...	Albuminuria.	.....
7	1407	II	2330	2190	2360	18	...	.....	.....
8	1409	II	2500	2400	2575	13	...	.....	.....
10	1422	III	2375	2225	2600	19	...	.....	.....
15	1441	II	2475	2300	2750	25	...	.....	.....
16	1443	I	2500	2290	2380	23	...	.....	.....
18	1450	I	1330	1230	2270	Nov. 16	...	.....	.....
18	1451	I	2340	2200	2375	Oct. 26	...	.....	.....
20	1459	II	2100	1950	2060	31	...	Twin birth.	.....
20	1459	II	2500	2350	2450	31	...	.....	.....
24	1475	I	2425	2300	2420	30	...	.....	.....
Nov. 3	1508	III	2350	2025	2100	Nov. 11	...	.....	.....
4	1513	I	1850	1650	2280	Dec. 3	...	Albuminuria.	.....
4	1518	III	2500	2350	2475	Nov. 12	...	"	.....
5	1522	I	2130	1980	2375	19	...	.....	.....
7	1526	II	2325	2175	2600	21	...	.....	Antepartum ophthalmia.
7	1528	II	1625	1450	...	...	...	.....	.....
8	1529	I	1400	1350	1460	Nov. 17	...	.....	.....
9	1531	I	1510	1375	1420	16	...	.....	.....
16	1554	II	2325	2225	2375	26	...	.....	.....
22	1574	I	2320	2200	2250	Dec. 2	...	"	.....
22	1579	I	2030	1925	2475	15	...	"	.....
Dec. 2	1620	I	2450	2250	2400	Dec. 10	...	.....	.....
4	1624	II	2075	1775	2360	Jan. 12	...	.....	.....
6	1633	I	1950	1715	...	Jan. 26	+	.....	.....
10	1650	II	2000	2000	2450	Dec. 19	...	.....	Syphilis.
10	1653	I	1250	1075	...	13	+	.....	Cyanosis.
11	1658	IX	2375	2175	2330	20	...	.....	.....
13	1662	V	2450	2340	2460	23	...	Version.	.....
16	1674	I	1980	1850	2450	Jan. 4	...	Twin birth.	.....
17	1681	II	2500	2350	2650	Dec. 26	...	Albuminuria.	.....
19	1690	V	2500	2025	2125	30	...	"	.....
29	1731	II	2450	2350	2425	Jan. 8	...	.....	.....

## CLINIQUE TARNIER.—DEPARTMENT FOR WEAKLINGS, 1898.

*Infants Grouped in Categories according to their Weight.*

DATE.	1000 to 1500	1500 to 2000	2000 to 2500	DATE.	1000 to 1500	1500 to 2000	2000 to 2500
March	352†	336	315 391	August	1145†	1133	1094 1140
"	...	378†	316 404†	"	...	...	1103 1171
"	...	378 (2) †	332 410	"	...	...	1109 1230
"	...	432	340 420	"	...	...	1118 1231
"	...	...	376 423†	"	...	...	1119 1239
"	...	...	388 449	"	...	...	1120
	1	4	12		1	1	11
April	...	574	458† 512†	September	1282	1284	1256 1327
"	...	...	466 576	"	...	1285†	1266 1337
"	...	...	477 580	"	...	1312	1274 1362
"	...	...	480 593	"	...	1379	1293 1373
"	...	...	488	"	...	...	1297 1375
		1	9	"	...	...	1305 1376
May	...	634	599 676	"	...	...	1311 1377
"	...	662	630 687	"	...	...	1312 1378
"	...	673	640 709		1	4	16
"	...	689	642 732	October	1450	...	1389 1443
"	...	699	651 740	"	...	...	1402 1451
"	...	...	658† 748	"	...	...	1407 1459
		5	12	"	...	...	1409 1459
June	...	759	765 833	"	...	...	1422 1475
"	...	761	804 844	"	...	...	1441
"	...	765†	810 859†		1		11
"	...	800	813 869	November	1529	1513	1508 1554
"	...	808	816 868	"	...	1528	1518 1574
"	...	...	817 876	"	...	1531	1522 1579
"	...	...	817 bis 878	"	...	...	1526
		5	14		1	3	7
July	...	904 1056	906 986	December	1653†	1633†	1620 1681
"	...	933 1071	937 988	"	...	1650	1624 1690
"	...	967	979 1006†	"	...	1674	1658 1731
"	...	1032	980 1009	"	...	...	1662
"	...	1056	984 1060		1	3	7
		7	10				

## CLINIQUE TARNIER.—WEAKLINGS, 1898.

*Results.*

DATES.	Infants from 1000 to 1500.	Infants Dead.	Infants Alive.	Infants from 1500 to 2000.	Infants Dead.	Infants Alive.	Infants from 2000 to 2500.	Infants Dead.	Infants Alive.
March . . . .	1	1	...	4	3	1	12	2	10
April . . . .	...	...	...	1	...	1	9	2	7
May . . . .	...	...	...	5	...	5	12	1	11
June . . . .	...	...	...	5	1	4	14	1	13
July . . . .	...	...	...	7	...	7	10	1	9
August . . . .	1	1	...	1	...	1	11	...	11
September . . . .	1	...	1	4	1	3	16	...	16
October . . . .	1	...	1	...	...	...	11	...	11
November . . . .	1	...	1	3	...	3	7	...	7
December . . . .	1	1	...	3	1	2	7	...	7
Total per categories .	6	3	3	33	6	27	109	7	102

MONTH.	Deaths within 24 Hours.		Deaths between 24 and 48 Hours.		OBSERVATIONS.
	Numbers.	Weight.	Numbers.	Weight.	
March . . . .	{ 323 367 437 624	1060 1680 2130 2200	...	...	10 hours. Cyanosis.
May . . . .	{ ... 717 735 764	... 1000 1800 1800	646	2010	Syphilis. .... ..... Prolapse of the cord, mother albumin. Mother albuminuria.
June . . . .	{ 847 890 999	1950 1800 1100	...	...	" ..... Syphilis. .... Hæm. infarcts in the placenta.
July . . . .	{ 1055 1059 1105	2140 1950 1000	...	...	..... ..... .....
August . . . .	{ 1105 1257	1000 1400	1161	1000	Version. Mother albuminuria.
September . . . .	{ ... 1404	... 1500	1282	1520	Twins. Fatty degeneration of the placenta.
November . . . .	{ 1548 1552	1150 1820	...	...	..... Prolapse of the cord.
December . . . .	{ 1623	1150	...	...	Twin birth.

## APPENDIX II

QUANTITIES OF MILK FURNISHED EACH DAY BY THE WET-NURSES TO THE VARIOUS INFANTS UNDER THEIR CARE.

WET-NURSE DEN—

*Confined May 10, 1897. Entered June 5, 1897.*

1897.				
June	5-6	$\left\{ \begin{array}{l} \text{Pér.} . . . 190 \\ \text{Bres} . . . 120 \\ \text{Devan.} . . . 70 \\ \text{Den} . . . 170 \end{array} \right\}$	550	
	6-7	$\left\{ \begin{array}{l} \text{Pér.} . . . 440 \\ \text{Bres} . . . 290 \\ \text{Jul} . . . 80 \\ \text{Den} . . . 230 \end{array} \right\}$	1040	
	7-8	$\left\{ \begin{array}{l} \text{Pér.} . . . 490 \\ \text{Bres} . . . 430 \\ \text{Jul} . . . 90 \\ \text{Den} . . . 350 \end{array} \right\}$	1360	
	8-9	$\left\{ \begin{array}{l} \text{Pér.} . . . 360 \\ \text{Bres} . . . 390 \\ \text{Guy} . . . 160 \\ \text{Den} . . . 390 \end{array} \right\}$	1300	
	9-10	$\left\{ \begin{array}{l} \text{Pér.} . . . 390 \\ \text{Bres} . . . 410 \\ \text{Guy} . . . 320 \\ \text{Den} . . . 580 \end{array} \right\}$	1700	
	12-1	$\left\{ \begin{array}{l} \text{Pér.} . . . 510 \\ \text{Bres} . . . 390 \\ \text{Guy} . . . 340 \\ \text{Den} . . . 520 \end{array} \right\}$	1760	
	13-14	$\left\{ \begin{array}{l} \text{Pér.} . . . 460 \\ \text{Bres} . . . 380 \\ \text{Guy} . . . 330 \\ \text{Den} . . . 460 \end{array} \right\}$	1630	
The wet-nurse's child has diarrhœa.				
	15-16	$\left\{ \begin{array}{l} \text{Pér.} . . . 430 \\ \text{Bres} . . . 330 \\ \text{Guy} . . . 310 \\ \text{Den} . . . 400 \end{array} \right\}$	1470	
	16-17	$\left\{ \begin{array}{l} \text{Pér.} . . . 370 \\ \text{Bres} . . . 330 \\ \text{Guy} . . . 340 \\ \text{Den} . . . 380 \end{array} \right\}$	1420	
The wet-nurse's child has diarrhœa.				
June	17-18	$\left\{ \begin{array}{l} \text{Pér.} . . . 400 \\ \text{Bres} . . . 390 \\ \text{Guy} . . . 410 \\ \text{Den} . . . 380 \end{array} \right\}$	1580	
	18-19	$\left\{ \begin{array}{l} \text{Pér.} . . . 480 \\ \text{Bres} . . . 380 \\ \text{Guy} . . . 380 \\ \text{Den} . . . 740 \end{array} \right\}$	1930	
	19-20	$\left\{ \begin{array}{l} \text{Pér.} . . . 450 \\ \text{Bres} . . . 330 \\ \text{Guy} . . . 360 \\ \text{Den} . . . 440 \end{array} \right\}$	1580	
	20-21	$\left\{ \begin{array}{l} \text{Pér.} . . . 490 \\ \text{Bres} . . . 380 \\ \text{Guy} . . . 360 \\ \text{Den} . . . 440 \end{array} \right\}$	1690	
	21-22	$\left\{ \begin{array}{l} \text{Pér.} . . . 390 \\ \text{Bres} . . . 320 \\ \text{Guy} . . . 360 \\ \text{Den} . . . 470 \end{array} \right\}$	1540	
	22-23	$\left\{ \begin{array}{l} \text{Pér.} . . . 410 \\ \text{Bres} . . . 340 \\ \text{Guy} . . . 430 \\ \text{Den} . . . 450 \end{array} \right\}$	1630	
	23-24	$\left\{ \begin{array}{l} \text{Pér.} . . . 440 \\ \text{Bres} . . . 360 \\ \text{Guy} . . . 390 \\ \text{Den} . . . 490 \end{array} \right\}$	1580	
	24-25	$\left\{ \begin{array}{l} \text{Pér.} . . . 470 \\ \text{Bres} . . . 410 \\ \text{Guy} . . . 440 \\ \text{Den} . . . 500 \end{array} \right\}$	1820	



## WET-NURSE MART—

*Delivered May 26, 1897. Entered June 11, 1897.*

1897.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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## WET-NURSE ALO—

*Delivered May 25, 1897. Entered June 11, 1897.*

1897.

June 12-13 . .	{ Réot . . . 370 } { Alo . . . 350 }	720	June 20-21 . .	{ Char . . . 350 } { Lec . . . 460 } { Alo . . . 410 }	1220
13-14 . .	{ Réot . . . 320 } { Char . . . 270 } { Alo . . . 400 }	990	21-22 . .	{ Char . . . 340 } { Lec . . . 410 } { Ran . . . 350 } { Alo . . . 420 }	1520
15-16 . .	{ Réot . . . 320 } { Char . . . 290 } { Alo . . . 600 }	1210	22-23 . .	{ Char . . . 300 } { Lec . . . 400 } { Ran . . . 340 } { Suz. 12 h. seult. 220 } { Alo . . . 490 }	1750
16-17 . .	{ Char . . . 430 } { Alo . . . 810 }	1240	23-24 . .	{ Char . . . 300 } { Lec . . . 390 } { Suzanne . . . 370 } { Alo . . . 490 }	1550
17-18 . .	{ Char . . . 300 } { Alo . . . 800 }	1100	24-25 . .	{ Suzanne . . . 340 } { Char . . . 320 } { Lec . . . 420 } { Alo . . . 430 }	1510
18-19 . .	{ Char . . . 340 } { Alo . . . 360 }	700			
19-20 <sub>a</sub> . .	{ Char . . . 360 } { Lec . . . 430 } { Alo . . . 390 }	1180			

## APPENDIX III

DAILY QUANTITIES OF MILK FURNISHED BY THE WET-NURSES AT THE DEPARTMENT FOR WEAKLINGS, TO THEIR VARIOUS CHARGES, AS DETERMINED BY WEIGHING ONCE EACH WEEK

WET-NURSE ANDR—— (19 Years).

*Delivered November 14, 1896. Entered December 13, 1896.*

1897.	{ Dem . . . 460 Led . . . 390 Prudence . . 550 André . . . 590 }	1990	May 12-13 . . { Gend . . . 390 26th week { André . . . 830 }	1220
Jan. 15-16 . . {			May 19-20 . . { Gend . . . 400 27th week { Gand . . . 420 André . . . 880 }	1700
9th week			May 26-27 . . { Lesag . . . 340 28th week { Vale . . . 380 André . . . 900 }	1620
Feb. 5-6 . . {		1740	June 2-3 . . { Royer . . . 450 29th week { Vale . . . 410 André . . . 870 }	1730
12th week			June 9-10 . . { Royer . . . 500 30th week { Vale . . . 260 Sch . . . 370 André . . . 810 }	1940
Feb. 22-23 . . {		1700	June 16-17 . . { Royer . . . 540 31st week { Sch . . . 400 André . . . 810 }	1750
15th week			June 23-24 . . { Royer . . . 560 32nd week { René . . . 440 Sch . . . 410 André . . . 670 }	2080
Mar. 10-11 . . {		1810	June 30-July 1 { René . . . 440 33rd week { Royer . . . 590 Sch . . . 380 André . . . 620 }	2030
17th week			July 7-8 . . { René . . . 480 34th week { Royer . . . 610 Loust . . . 185 André . . . 960 }	2235
Mar. 17-18 . . {		1700	July 14-15 . . { René . . . 490 35th week { Viesc . . . 270 Queffel . . . 380 André . . . 720 }	1860
18th week			July 21-22 . . { René . . . 500 36th week { Queffel . . . 410 André . . . 930 }	1840
Mar. 31-April 1 {		1180		
20th week				
April 7-8 . . {		1720		
1st week				
April 14-15 . . {		1570		
22nd week				
April 21-22 . . {		1470		
23rd week				
April 28-29 . . {		1700		
24th week				
May 5-6 . . {		1510		
25th week				

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July 28-29 . . . 37th week	{ René . . . 430 Queffel . . . 380 Drou . . . 280 André . . . 900 }	1990	Oct. 20-21 . . . 49th week	{ Jouta . . . 570 Adrien . . . 510 Simon . . . 390 André . . . 560 }	2030
Aug. 4-5 . . . 38th week	{ René . . . 460 Queffel . . . 390 Ric . . . 570 André . . . 570 }	1990	Oct. 27-28 . . . 50th week	{ Jouta . . . 600 Grandgou . . . 480 Simon . . . 400 André . . . 550 }	2030
Aug. 11-12 . . . 39th week	{ Queffel . . . 400 René . . . 450 Rica . . . 570 André . . . 660 }	2080	Nov. 3-4 . . . 51st week	{ Jouta . . . 500 Grandgou . . . 590 Simon . . . 360 André . . . 500 }	1950
Aug. 18-19 . . . 40th week	{ Queffel . . . 440 Rica . . . 560 René . . . 490 André . . . 670 }	2160	Nov. 10-11 . . . 52nd week	{ Jouta . . . 540 Grandgou . . . 420 Simon . . . 280 André . . . 610 }	1850
Aug. 25-26 . . . 41st week	{ Queffel . . . 410 René . . . 540 Rica . . . 640 André . . . 590 }	2280	Nov. 17-18 . . . 53rd week	{ Jouta . . . 510 Grandgou . . . 440 Simon . . . 320 André . . . 620 }	1890
Sept. 1-2 . . . 42nd week	{ Queffel . . . 450 René . . . 470 Rica . . . 540 André . . . 610 }	2070	Nov. 24-25 . . . 54th week	{ Jouta . . . 540 Simon . . . 300 Grandgou . . . 460 André . . . 520 }	1820
Sept. 8-9 . . . 43rd week	{ Queffel . . . 450 René . . . 560 André . . . 650 }	1660	Dec. 1-2 . . . 55th week	{ Jouta . . . 590 Fer . . . 440 Grandgou . . . 540 André . . . 550 }	2120
Sept. 15-16 . . . 44th week	{ Jouta . . . 270 René . . . 510 Debri . . . 570 André . . . 590 }	1940	Dec. 8-9 . . . 56th week	{ Jouta . . . 530 Fer . . . 430 Bruni . . . 220 André . . . 460 }	1640
Sept. 22-23 . . . 45th week	{ René . . . 540 Jouta . . . 490 Sermon . . . 360 André . . . 450 }	1840	Dec. 15-16 . . . 57th week	{ Jouta . . . 520 Maq . . . 580 Bruni . . . 410 André . . . 570 }	2080
Sept. 29-30 . . . 46th week	{ René . . . 560 Jouta . . . 520 Juliette . . . 390 André . . . 560 }	2030	Dec. 22-23 . . . 58th week	{ Maq . . . 550 Jouta . . . 530 André . . . 540 }	1620
Oct. 6-7 . . . 47th week	{ René . . . 650 Jouta . . . 560 André . . . 750 }	1960	Dec. 29-30 . . . 59th week	{ Maq . . . 560 Jouta . . . 540 André . . . 600 }	1700
Oct. 13-14 . . . 48th week	{ Grandgou . . . 430 Jouta . . . 540 Eugène . . . 380 André . . . 670 }	2020	1898. Jan. 5-6 . . . 60th week	{ Drau . . . 640 Jouta . . . 580 André . . . 660 }	1880

WET-NURSE GAIL— (22 Years).

*Delivered July 16, 1896. Entered August 4, 1896.*

1896. Sept. 7-8 . . . 8th week	{ Jech . . . 120 Ja . . . 320 Gail . . . 470 }	910	Oct. 20-21 . . . 14th week	{ Cant . . . 305 Pav . . . 380 Jech . . . 440 Gail . . . 520 }	1640
Sept. 28-29 . . . 11th week	{ Pav . . . 360 Jech . . . 480 Gail . . . 610 }	1450	Nov. 16-17 . . . 17th week	{ Cant . . . 460 Pav . . . 400 Jech . . . 400 Gail . . . 640 }	1900

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Dec. 8-9 . . .	{ Lab . . . 580 Pav . . . 380 Cant . . . 400 Gail . . . 360 }	1720	June 16-17 . . .	{ Bar . . . 310 Réo . . . 360 Gail . . . 100 }	770
20th week			47th week		
Dec. 29-30 . . .	{ Pav . . . 500 Cant . . . 570 Sch . . . 290 Gail . . . 270 }	1630	June 23-24 . . .	{ Drou . . . 470 Réo . . . 400 Bar . . . 360 Gail . . . 390 }	1620
23rd week			48th week		
1897. Jan. 15-16 . . .	{ Pav . . . 450 Sch . . . 390 Charl . . . 360 Gail . . . 270 }	1470	June 30-July 1 . . .	{ Bar . . . 410 Dro . . . 470 Réo . . . 320 Gail . . . 490 }	1690
26th week			49th week		
Feb. 5-6 . . .	{ Pavie . . . 490 Sch . . . 490 Gail . . . 210 }	1190	July 7-8 . . .	{ Bar . . . 480 Réo . . . 410 Dro . . . 450 Gail . . . 340 }	1600
28th week			50th week		
Feb. 22-23 . . .	{ Sch . . . 440 Marcel . . . 320 Abraham . . . 320 Gail . . . 570 }	1650	July 14-15 . . .	{ Dro . . . 560 Bar . . . 450 Reb . . . 70 Gail . . . 460 }	1540
31st week			51st week		
Mar. 10-11 . . .	{ Sch . . . 450 Abraham . . . 440 Marcel . . . 430 Gail . . . 650 }	1970	July 21-22 . . .	{ Reb . . . 190 Bar . . . 390 Dro . . . 560 Gail . . . 260 }	1400
33rd week			52nd week		
Mar. 17-18 . . .	{ Sch . . . 460 Abraham . . . 460 Garg . . . 50 Gail . . . 580 }	1550	July 28-29 . . .	{ Reb . . . 260 Bar . . . 450 Dro . . . 560 Gail . . . 570 }	1840
34th week			53rd week		
Mar. 31-April 1 . . .	{ Aup . . . 420 Eloy . . . 420 Gail . . . 340 }	1180	Aug. 4-5 . . .	{ Dro . . . 590 Bar . . . 450 Anne . . . 60 Groist . . . 150 Gail . . . 530 }	1780
36th week			54th week		
April 7-8 . . .	{ Aup . . . 490 Gail . . . 520 }	1010	Aug. 11-12 . . .	{ Dro . . . 570 Groist . . . 120 Can . . . 350 Gail . . . 540 }	1580
37th week			55th week		
April 14-15 . . .	{ Aup . . . 490 Bra . . . 100 Gail . . . 630 }	1220	Aug. 18-19 . . .	{ Dro . . . 530 Vays . . . 110 Gail . . . 660 }	1300
38th week			56th week		
April 21-22 . . .	{ Bra . . . 320 Aup . . . 500 Gail . . . 590 }	1410	Aug. 25-26 . . .	{ Paul . . . 440 Philippe . . . 420 Gail . . . 660 }	1520
39th week			57th week		
April 28-29 . . .	{ Aup . . . 500 Gail . . . 600 }	1100	Aug. 1-Sept. 2 . . .	{ Paul . . . 430 Philippe . . . 460 Jourdain . . . 350 Gail . . . 500 }	1740
40th week			58th week		
May 5-6 . . .	{ Bert . . . 400 Gail . . . 560 }	960	Sept. 8-9 . . .	{ Paul . . . 450 Philippe . . . 410 Jour . . . 420 Gail . . . 440 }	1720
41st week			59th week		
May 12-13 . . .	{ Bert . . . 460 Barb . . . 190 Gail . . . 420 }	1070	Sept. 15-16 . . .	{ Philippe . . . 410 Paul . . . 390 Jour . . . 390 }	1190
42nd week			60th week		
May 19-20 . . .	{ Bert . . . 230 Barb . . . 340 }	570	Sept. 22-23 . . .	{ Paul . . . 450 Jour . . . 400 }	850
43rd week			61st week		
May 26-27 . . .	{ Bert . . . 340 Wial . . . 200 }	510			
44th week					
June 2-3 . . .	{ Bert . . . 370 Henri . . . 340 Matz . . . 200 }	910			
45th week					
June 9-10 . . .	{ Fernandz . . . 170 Mail . . . 250 Arsè . . . 460 Gail . . . 250 }	1230			
46th week					

# APPENDIX

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## WET-NURSE CAPIT—

*Delivered November 11, 1896. Entered December 16, 1896.*

1897. Jan. 15-16 . . . 10th week	{ Lem . . . 400 Req . . . 460 Capit . . . 420 }	1280	July 7-8 . . . 35th week	{ Mie . . . 600 Lec . . . 430 Capit . . . 600 }	1630
Feb. 5-6 . . . 13th week	{ Jerme . . . 480 Go . . . 330 Mart . . . 150 Capit . . . 420 }	1380	July 14-15 . . . 36th week	{ Mie . . . 690 Lec . . . 450 Alphons . . . 330 Capit . . . 650 }	2120
Feb. 22-23 . . . 15th week	{ Gou . . . 270 Thérèse . . . 390 Poi . . . 330 Capit . . . 860 }	1850	July 21-22 . . . 37th week	{ Alphons . . . 370 Lec . . . 420 Mie . . . 600 Capit . . . 510 }	1900
Mar. 10-11 . . . 18th week	{ Thérèse . . . 480 Sol . . . 370 Pav . . . 380 Capit . . . 600 }	1830	July 28-29 . . . 38th week	{ Alph . . . 460 Lecl . . . 560 Laur . . . 90 Capit . . . 500 }	1510
Mar. 17-18 . . . 19th week	{ Thérèse . . . 500 Sol . . . 380 Capit . . . 540 }	1420	Aug. 4-5 . . . 39th week	{ Lecl . . . 550 Marcelle . . . 440 Dupl . . . 250 Capit . . . 400 }	1610
Mar. 31-April 1 . . . 21st week	{ Schm . . . 360 Thérèse . . . 440 Capit . . . 680 }	1480	Aug. 11-12 . . . 40th week	{ Lecl . . . 480 Marcelle . . . 430 Dupl . . . 320 Capit . . . 450 }	1680
April 7-8 . . . 22nd week	{ Thérèse . . . 530 Capit . . . 720 }	1250	Aug. 18-19 . . . 41st week	{ Lecl . . . 560 Marcelle . . . 510 Dupl . . . 340 Capit . . . 510 }	1920
April 14-15 . . . 23rd week	{ Thérèse . . . 630 Capit . . . 510 }	1140	Aug. 25-26 . . . 42nd week	{ Dupl . . . 290 Marcelle . . . 480 Lecl . . . 630 Capit . . . 420 }	1820
April 21-22 . . . 24th week	{ Thérèse . . . 570 Louise . . . 60 Capit . . . 650 }	1280	Sept. 1-2 . . . 43rd week	{ Lecl . . . 620 Marcelle . . . 510 Méz . . . 90 Capit . . . 510 }	1730
April 28-29 . . . 25th week	{ Dub . . . 190 Capit . . . 560 }	710	Sept. 8-9 . . . 44th week	{ Marcelle . . . 590 Lecl . . . 510 Méz . . . 310 Capit . . . 400 }	1810
May 5-6 . . . 26th week	{ Dub . . . 380 Dug . . . 340 Capit . . . 570 }	1290	Sept. 15-16 . . . 45th week	{ Marcelle . . . 560 Cott . . . 240 Jacon . . . 180 Capit . . . 470 }	1450
May 12-13 . . . 27th week	{ Dub . . . 470 Capit . . . 650 }	1120	Sept. 22-23 . . . 46th week	{ Marcelle . . . 610 Surug . . . 190 Capit . . . 610 }	1410
May 19-20 . . . 28th week	{ Dub . . . 400 Sto . . . 200 Capit . . . 490 }	1090	Sept. 29-30 . . . 47th week	{ Marcelle . . . 650 Suru . . . 320 Rol . . . 400 Capit . . . 310 }	1680
June 9-10 . . . 31st week	{ Mie . . . 450 Suzanne . . . 280 Mign . . . 165 Capit . . . 380 }	1275	Oct. 6-7 . . . 48th week	{ Marcelle . . . 600 Suru . . . 410 Rol . . . 440 Capit . . . 510 }	1960
June 16-17 . . . 32nd week	{ Mie . . . 490 Suzanne . . . 310 Mign . . . 175 Capit . . . 570 }	1545			
June 23-24 . . . 33rd week	{ Mie . . . 540 Merc . . . 130 Capit . . . 600 }	1270			
June 30-July 1 . . . 34th week	{ Mie . . . 610 Lec . . . 460 Merc . . . 220 Capit . . . 560 }	1850			



Oct. 13-14 . . .	{ Suru . . . 550	1460	Dec. 8-9 . . .	{ Ant . . . 440	1650
49th week	{ Rol . . . 440		57th week	{ Bros . . . 340	
	{ Capit . . . 470			{ Jacq . . . 490	
Oct. 20-21 . . .	{ Suru . . . 500	1540	Dec. 15-16 . . .	{ Ant . . . 360	1740
50th week	{ Val . . . 60		58th week	{ Bros . . . 350	
	{ Lous . . . 460			{ Jacq . . . 540	
	{ Capit . . . 520			{ Capit . . . 490	
Oct. 27-28 . . .	{ Paul . . . 540	1670	Dec. 22-23 . . .	{ Ant . . . 400	1370
51st week	{ Sur . . . 490		59th week	{ Jacq . . . 480	
	{ Jup . . . 240			{ Capit . . . 490	
	{ Capit . . . 400				
Nov. 3-4 . . .	{ Sur . . . 480	1370	Dec. 29-30 . . .	{ Ant . . . 500	1390
52nd week	{ Jacq . . . 350		60th week	{ Jacq . . . 420	
	{ Sch . . . 40			{ Capit . . . 470	
	{ Capit . . . 500				
Nov. 10-11 . . .	{ Sur . . . 490	1500	Jan. 1898.	{ Ant . . . 420	1360
53rd week	{ Bros . . . 220		5-6 . . .	{ Jacq . . . 540	
	{ Jacq . . . 430		61st week	{ Capit . . . 400	
	{ Capit . . . 360				
Nov. 17-18 . . .	{ Sur . . . 530	1560	Jan. 11-12 . . .	{ Ant . . . 480	1560
54th week	{ Jacq . . . 330		62nd week	{ Ble . . . 240	
	{ Bros . . . 300			{ Roc . . . 370	
	{ Capit . . . 400			{ Capit . . . 470	
Nov. 24-25 . . .	{ Sur . . . 490	1590	Jan. 19-20 . . .	{ Ant . . . 510	1690
55th week	{ Bros . . . 330		63rd week	{ Bouff . . . 370	
	{ Jacq . . . 370			{ Gom . . . 520	
	{ Capit . . . 400			{ Capit . . . 290	
Dec. 1-2 . . .	{ Sur . . . 520	1710	Jan. 26-27 . . .	{ Can . . . 70	2180
56th week	{ Bros . . . 330		64th week	{ Ant . . . 520	
	{ Jacq . . . 480			{ Risq . . . 380	
	{ Capit . . . 380			{ Capit . . . 580	

## APPENDIX IV

### MUNICIPAL COUNCIL OF PARIS (1897) MILK COMMISSION (Synopsis of Report)

THE following was adopted as the average composition of cows' milk per litre :—

Water	.	.	.	.	.	.	870 parts
Solids	.	.	.	.	.	.	130 parts, which comprise—
Butter	.	.	.	.	.	.	40 parts
Lactose	.	.	.	.	.	.	50 „
Salts, &c.	.	.	.	.	.	.	} 40 „
Casein	.	.	.	.	.	.	
Extractives	.	.	.	.	.	.	

To determine the quality of milk consumed in Paris, samples were collected, haphazard and simultaneously, of that offered for sale in each of the twenty districts of the city on 1st June 1897. The following were the results of their analysis :—

DISTRICTS.							Percentage of Butter.	Percentage of Butter Removed.	Percentage of Water Added.
1st district	.	.	.	.	.	.	3.17	20.8	...
2nd „	.	.	.	.	.	.	2.16	43.2	4.0
3rd „	.	.	.	.	.	.	3.52	12.0	...
4th „	.	.	.	.	.	.	2.72	28.5	3.8
5th „	.	.	.	.	.	.	3.00	16.7	8.0
6th „	.	.	.	.	.	.	2.89	21.9	5.9
7th „	.	.	.	.	.	.	1.91	49.3	6.0
8th „	.	.	.	.	.	.	2.51	37.3	...
9th „	.	.	.	.	.	.	2.33	41.8	...
10th „	.	.	.	.	.	.	3.60	10.0	...
11th „	.	.	.	.	.	.	3.07	23.3	...
12th „	.	.	.	.	.	.	1.53	59.8	3.2
13th „	.	.	.	.	.	.	2.91	21.4	6.7
14th „	.	.	.	.	.	.	2.70	20.6	12.9
15th „	.	.	.	.	.	.	2.58	35.5	...
16th „	.	.	.	.	.	.	1.78	45.1	18.8
17th „	.	.	.	.	.	.	3.27	18.3	...
18th „	.	.	.	.	.	.	2.46	38.5	...
19th „	.	.	.	.	.	.	3.46	11.3	2.5
20th „	.	.	.	.	.	.	2.12	47.0	...
Average	.	.	.	.	.	.	2.68	30.1	...

This table is represented graphically on Fig. 78.

Six times only did the milk contain more than 30 grams of butter; fourteen times it had less than 30 grams; and some samples contained as little as 19, 17, and even 15 grams. All had been skimmed; some had also been watered.

Some cows yield milk which has more than 40 grams of butter per litre; others that which has less. But fat is not the only nutritive constituent of milk; the casein, lactose and salts also contribute to its value as a food; so these milks, less rich in butter, may still have considerable nourishing power.

The Commission suggested that the standard for solids, other than butter, should be fixed at 90 grams per litre. Milk containing less than this amount has probably been watered.

The Commission proposed that all milks should be divided into three categories :—

1. *Very Good*—that containing 40 grams of butter per litre.
2. *Good*—that containing 35 to 40 grams.
3. *Poor*—that containing from 30 to 35 grams.

Any liquid containing less than 30 grams of butter per litre should no longer be considered as milk, and its sale as such should constitute fraud.

Milk should be obtained only from healthy cows; it should be the product of the complete milking, and neither creamed nor watered.

All cows should be tested with tuberculin, and the milk of those only which have been proved healthy should be used unsterilised. A veterinary surgeon should inspect every cow at least once a month. Any cow recognised to be ill should be at once isolated, and its milk kept apart till the veterinary surgeon decides whether it is fit for human consumption or not.

Want of cleanliness in milking was said to be the great cause of the impurity of milk. The precautions to be observed in byres and dairies were indicated.

No milk should be considered fit for human consumption which does not undergo without change :—

1. Heating for fifteen minutes at a temperature between 30° and 40° C.
2. Boiling for five minutes.

The Commission said that no method of preservation of milk by chemical means was permissible. Pasteurisation and refrigeration were recommended as measures which retard the multiplication of organisms during the transport of milk. It was advised to boil or sterilise all milk before use.

To inculcate this principle into the rising generation M. Nocaud suggested that in every school the following notice should be prominently placed :—

“Do not drink unboiled milk and you will avoid many diseases.

“All milk which is to be kept more than twenty-four hours must be rendered absolutely sterile. This may be attained either by one prolonged heating at 110° C. or by discontinuous heating below this temperature.

“Milk intended for infants should be sterilised by heating to 100° C. for forty-five minutes, and distributed in small bottles, each containing only enough for one feed.

“To avoid fraud in transit from dairy to consumer milk should be conveyed in sealed vessels of varying capacity each absolutely full.

“Sterilised milk ought to be procurable, free of charge, by all necessitous nursing mothers from the public authorities, on producing a doctor's certificate stating that it is for the use of a child under two years of age. Poor invalids should enjoy the same privileges as infants, and those for whom sterilised milk is contra-indicated ought to be able to obtain pure fresh milk of good quality.”

Paris consumes annually about 200 million litres of milk at a cost of  $54\frac{1}{2}$  million francs, approximately. Farmers receive almost 28 million francs, and the remainder,  $26\frac{1}{2}$  million francs, is expended in transport and in middlemen's charges.

The milk supply of Paris has three sources :—

1. The produce of cows kept in Paris.
2. The produce of cows kept in the vicinity of the capital.
3. That brought to Paris on the railways.

According to Vincey, these sources contributed the following proportions for the year 1895 :—

SOURCE.	Number of Litres in.	Percentage of Total Supply.
Dairies in Paris . . . . .	2,153,500	10
Dairies in the neighbourhood . . . . .	5,322,890	25
More remote sources (by rail) . . . . .	13,511,110	65
	20,987,500	100

Sixty-five per cent. therefore came by rail from places more or less distant from the capital.

“The transport of milk is thus a very important question. Waggon should be specially constructed so as to minimise shaking, which causes the butter to form in small masses. Speedy transit is essential.”

The Commission also recommended the reduction of railway tariffs, the dating of all commercial sterilised milk, the foundation of a dairy school, and the creation of a central municipal depot for pasteurising and sterilising milk.

## APPENDIX V

### RESEARCHES ON THE TEMPERATURE OF MILK DURING THE PROCESS OF STERILISATION

M. CHAVANE demonstrated in my laboratory at the Charité that milk immersed in boiling water for forty-five minutes attained the temperature of the water— $100^{\circ}$  C. His results, however, have been disputed. Marfan<sup>1</sup> writes: "What is the actual temperature of the milk contained in the small bottles when surrounded by the boiling water of the steriliser for forty-five minutes? Some say that it does not exceed  $80^{\circ}$  C.; Chavane alleges that it reaches  $100^{\circ}$  C.; so I re-investigated the question. During various phases of the sterilisation I placed a thermometer, graduated to  $200^{\circ}$  C., in the small bottles. After a quarter of an hour the temperature of the milk is between  $90^{\circ}$  and  $92^{\circ}$  C.; after half-an-hour, between  $95^{\circ}$  and  $96^{\circ}$  C. As I never found it surpass the last figure, the casein ferment is probably not destroyed by this process. The efficiency of the sterilisation varies with the duration of the heat: according to Freer, after fifteen minutes heating several hundreds of colonies develop within twenty-four hours; after thirty minutes, several dozens; and after forty-five minutes sterile plates are often obtained. Rodet corroborates these results."

I asked M. Nicloux to repeat M. Chavane's experiment. He did so, avoiding all possible sources of error with the greatest care. His results show that the milk quite readily attains a temperature in the neighbourhood of  $100^{\circ}$ , viz.  $99.9^{\circ}$  C. One cannot conceive how it could be otherwise. He used a specially constructed thermometer of great precision, graduated in fifths of a degree to  $200^{\circ}$  C. Variations of  $\frac{1}{10}$  of a degree could be readily appreciated by it. The experiments were carried out with the same apparatus as is daily used to sterilise milk in the Clinique. M. Nicloux says: "I placed one thermometer in the water of the steriliser, and another in one of the small bottles containing the milk which was being sterilised. As I could not then put on the lid, I used a folded towel to prevent the steam escaping too freely. Temperature readings were taken every five minutes, as is seen in the first curve (the abscissa represents time; the ordinate, degrees Centigrade). The dotted line marks the beginning of boiling; the temperature at boiling-point was  $96^{\circ}$  C. in the steriliser, and  $77^{\circ}$  C. in the small bottles. After this point was reached, readings were taken every two and a half minutes. Ten minutes later the temperature was found to be  $100^{\circ}$  C. in the steriliser and  $99^{\circ}$  C. in the small bottles. On multiplying the ordinate by 20 (Curve 2) one finds, that while the temperature of the water remains constant at  $100^{\circ}$  C., that of the milk in the small bottles rises till it attains  $99.9^{\circ}$  C., but no further."

<sup>1</sup> Marfan, *Traité de l'allaitement et de l'alimentation des enfants*, Paris, 1899.



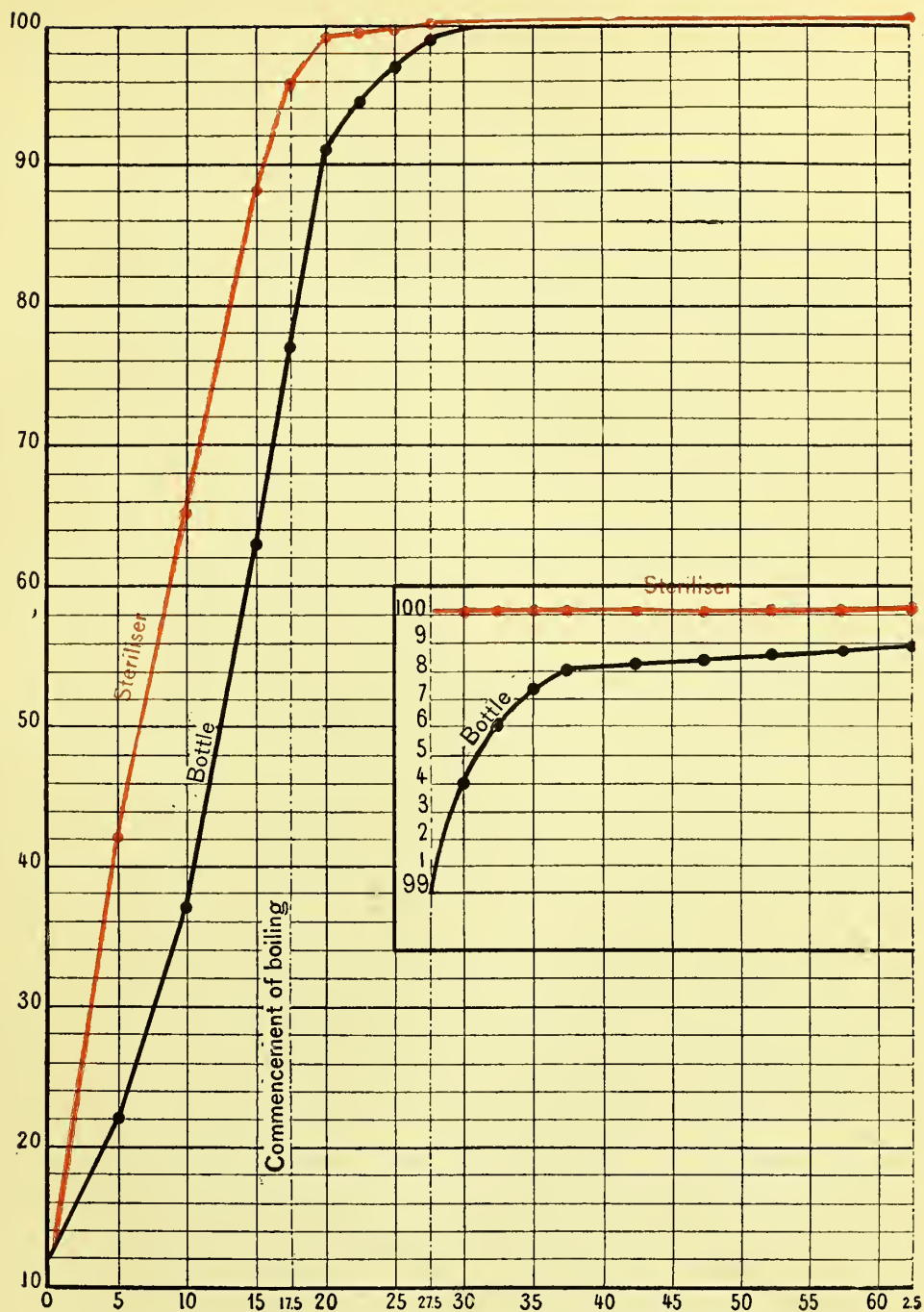


FIG. 124.—Curve of the temperature of the water contained in the steriliser, and of the bottles immersed in it.



## APPENDIX VI

REPRODUCTION OF THE CHART USED IN THE CLINIQUE  
TARNIER FOR RECORDING THE QUANTITIES OF MILK  
TAKEN BY AN INFANT AT EACH MEAL DURING THE  
TWENTY-FOUR HOURS

No. ....

Bed .....

Date .....

1900. No. 238. M. 1835.

Hours.	Mother.	Wet-nurse.	Ster. Milk.	OBSERVATIONS.
3 P.M.				
5 P.M.				
7 P.M.				
10 P.M.				
1 A.M.				
4 A.M.				
7 A.M.				
9 A.M.				
11 A.M.				
1 P.M.				
TOTAL				

## APPENDIX VII

REPRODUCTION OF THE CARD GIVEN TO MOTHERS ON  
THEIR DEPARTURE FROM THE HOSPITAL, AND PRE-  
SENTED BY THEM ON JOINING THE CONSULTATION

RÉPUBLIQUE FRANÇAISE.—LIBERTÉ—ÉGALITÉ—FRATERNITÉ

### CLINIQUE D'ACCOUCHEMENT TARNIER

89 RUE D'ASSAS

#### CONSULTATION DES NOURRISSONS

*Friday Morning at 9 o'clock*

1898. No. 33.—M. 36.	NAME.		NO. OF THE ACCOUCHE- MENT.		REMARKS.
	BIRTH.		DEPARTURE.		
	Date.	Weight.	Date.	Weight.	

REPRODUCTION OF THE CARD GIVEN TO MOTHERS WHO FOLLOW THE CONSULTATION. ON IT ARE NOTED ALL DETAILS CONCERNING THE INFANT

[illegible]



## APPENDIX IX

### RESULTS OBTAINED AT THE CONSULTATION FOR NURS- LINGS OF THE CLINIQUE TARNIER DURING THE MONTHS OF JUNE, JULY, AUGUST, AND SEPTEMBER 1899

*Synopsis of a Paper by Dr. Pierre Planchon, which appeared in the "Obstetrique"  
of January 1900*

After a few introductory remarks Dr. Planchon proceeds: "Now let us consider what happened, during summer 1899, at the Consultation for Nurslings of the Clinique Tarnier:—

"The Consultation then comprised 65 infants, of whom

40 were being exclusively breast-fed;

3 had been breast-fed until their mothers could no longer supply their wants, and were on mixed feeding;

22 were on artificial feeding, of whom 9 had been weaned in due course after passing through the stages of breast and mixed feeding, 10 had been on mixed feeding from birth, and 3 had been reared solely on animal milk.

"Consequently 40 infants were breast-fed, 22 received all the milk their mothers could secrete, and 3 had never had any but sterilised cows' milk. Therefore—

61.5 per cent. were nourished exclusively by their mothers.

33.7 „ utilised all the milk their mothers could produce.

4.6 „ were upon artificial feeding from birth.

"I have carefully collected the details of all gastro-intestinal troubles which occurred in these nurslings during the summer of 1899."

Dr. Planchon enters into a minute study of each case, and then continues as follows: There were 14 cases of diarrhoea among these 65 infants; 10 were slight and 4 were serious; there were no deaths. The morbidity was thus 21 per cent., and the mortality zero. In all but one case we traced the cause of the gastro-intestinal symptoms; in 5 they arose from "teething"; in 1 from menstruation in the nurse; and in 7 from faulty feeding, due to mothers disobeying our instructions.

What were the results obtained during the same period at the three crèches in Paris, where sterilised milk is used under proper supervision? As is seen

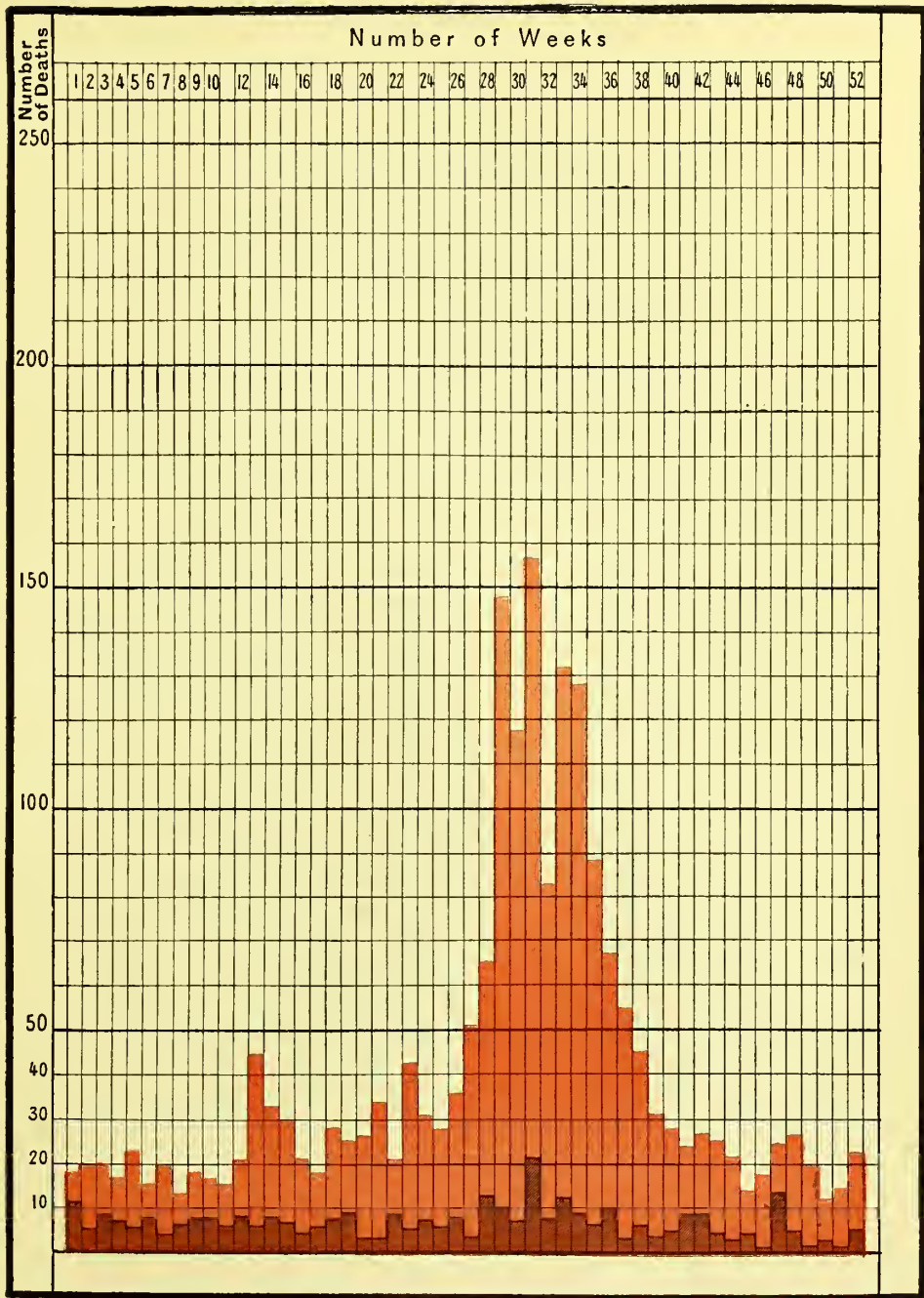


FIG. 125.—Mortality from gastro-enteritis in Paris during the year 1899. In red, mortality among bottle-fed infants; in black, mortality among breast-fed infants.



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on the following table they had a morbidity of 7.4 per cent. among 121 infants, and a mortality of zero.

Crèche.	Doctor.	Total of Infants.	Simple Enteritis.	Cholera Infantum.	Deaths.
Fénelon, Charles . . .	Dr. Bouquet	42	5	0	0
Rue Gauthey . . .	Dr. Gauchas	22	2	1	0
Sainte Philomène . . .	Dr. Belluze	57	1	0	0
Total . . . . .		121	8	1	0

In the town of Paris during these four months 2840 infants under one year died; 1470 of them succumbed to diarrhœa. The deaths from gastro-enteritis were thus 51.7 per cent. of the total infantile mortality; 139 of them—4.9 per cent.—occurred among breast-fed babies, and 1331—46.8 per cent.—among bottle-fed.

Number of Week.	Total Deaths from 0-1 Year.	Deaths from Gastro-enteritis.			Mean Temperature.	Percentage of the Total Infantile Death-rate due to Diarrhœa.
		Breast.	Bottle.	Total.		
					Degrees C.	Per Cent.
June 22	128	9	21	30	15.10	23.4
23	149	5	43	48	18.22	32.2
24	114	7	31	38	15.29	33.3
25	103	5	28	33	16.79	32.0
26	111	7	36	43	18.17	38.8
July 27	114	3	51	54	16.65	47.4
28	169	13	66	79	20.30	46.5
29	237	10	149	159	22.38	67.5
30	206	7	117	124	19.08	60.2
Aug. 31	256	16	158	174	23.57	68.0
32	231	7	84	91	19.55	39.5
33	215	12	131	143	20.98	60.5
34	210	9	128	137	19.86	65.2
35	175	6	88	94	19.23	53.8
Sept. 36	135	10	67	77	19.80	57.0
37	104	3	55	58	14.50	53.6
38	105	6	46	52	14.46	49.4
39	78	4	32	36	12.98	46.2
Total	2840	139	1331	1470		

## APPENDIX X

### INFANTILE MORTALITY

BALESTRE and Giletta de Saint Joseph (of Nice) compiled Statistics of Paris and the towns of France which have more than 30,000 inhabitants, comprising a total population of 7,300,000.

Their tables show that from 1892 to 1897 out of every 1000 deaths at all ages 166.2 occurred in infants under one year.

This was the average proportion, but sometimes it was greater. In 1897, for example, the deaths among infants under one year bore the following ratios to the deaths at all ages:—

Châlons-sur-Marne . . . . .	200.34 per 1000	Elbeuf . . . . .	240.35 per 1000
Caudebec-lès-Elbeuf . . . . .	200.83 "	Beauvais . . . . .	241.09 "
Arras . . . . .	201.21 "	Troyes . . . . .	243.92 "
Nancy . . . . .	201.68 "	Rouen . . . . .	246.95 "
Saint-Chamond . . . . .	201.98 "	Montreuil-sous-Bois . . . . .	247.43 "
Denain . . . . .	202.02 "	Hazebrouck . . . . .	249.89 "
Aubervilliers . . . . .	202.99 "	La Ciotat . . . . .	250.96 "
Le Cateau . . . . .	203.39 "	Fécamp . . . . .	252.56 "
Toul . . . . .	205.13 "	Reims . . . . .	253.50 "
Argenteuil . . . . .	210.52 "	Meaux . . . . .	254.02 "
Saint-Ouen . . . . .	213.59 "	Annonay . . . . .	259.82 "
Douarnenez . . . . .	214.28 "	Calais . . . . .	260.33 "
La Seyne-sur-Mer . . . . .	217.65 "	Bailleul . . . . .	262.02 "
Firminy . . . . .	218.52 "	Hautmont . . . . .	272.11 "
Epinal . . . . .	220.29 "	Saint-Denis . . . . .	277.25 "
Alfortville . . . . .	220.93 "	Dieppe . . . . .	290.13 "
Puteaux . . . . .	221.00 "	Hénin-Liétard . . . . .	291.26 "
Boulogne-sur-Mer . . . . .	221.09 "	Belfort . . . . .	300.37 "
Alais . . . . .	221.34 "	Lille . . . . .	307.00 "
Vesoul . . . . .	223.99 "	Roubaix . . . . .	312.86 "
Salon . . . . .	226.24 "	La Madeleine . . . . .	314.85 "
Lambezellec . . . . .	226.41 "	Tourcoing . . . . .	324.42 "
Clichy . . . . .	226.97 "	Lens . . . . .	333.34 "
Lunéville . . . . .	232.39 "	Dunkerque . . . . .	344.24 "
Chauny . . . . .	232.87 "	Le Grand'Combe . . . . .	345.89 "
Saint-Dié . . . . .	234.62 "	Watrelos . . . . .	353.49 "
Pantin . . . . .	235.52 "	Bolbec . . . . .	346.15 "
Saint-Quentin . . . . .	235.75 "	Bruay . . . . .	352.11 "
Sotteville-lès-Rouen . . . . .	237.29 "	Liévin . . . . .	378.48 "
Le Havre . . . . .	237.22 "	Croix . . . . .	400.83 "
Villeurbanne . . . . .	238.04 "	Marc-en-Barœul . . . . .	438.20 "
Armentières . . . . .	240.02 "	Halluin . . . . .	504.85 "

In these towns, therefore, the mortality under one year was equal to one-fifth, one-quarter, one-third, and even one-half of the total death-rate.



Out of every 1000 infantile deaths 385 are caused by diarrhœa, and 147 by pulmonary affections; these two, therefore, give rise to more than half the total death-rate among infants (532 out of every 1000—Fig. 126).

All other causes combined (eruptive fevers, contagious diseases, congenital debility, &c.) contribute only 468 out of every 1000 deaths.

Diarrhœa persists throughout the year, but it is particularly virulent during summer. In Fig. 128 its relative fatality during the different months is shown; least in January and February, it becomes more deadly as the atmospheric temperature rises.

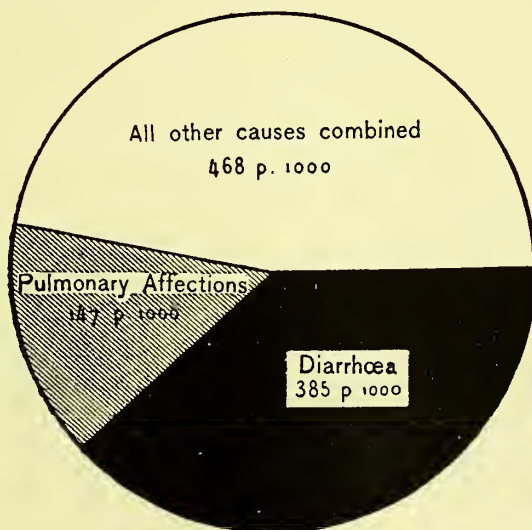


FIG. 126.—Graphic representation of the relative frequency of the various causes of death in infants under one year.

The proportion of deaths from diarrhœa is 224.8 per 1000 in March.

"	"	254.8	"	April.
"	"	301.1	"	May.
"	"	426.4	"	June.
"	"	587	"	July.
"	"	604.7	"	August.

It begins to fall as the weather grows colder.

It is no more than 537.7 per 1000 in September.

"	431.5	"	October.
"	304.4	"	November.
"	235.9	"	December.

The mortality due to digestive troubles is thus considerable. In July, August, and September, diarrhœa gives rise to more than half of the infantile deaths (587, 604.7, and 537.7 per 1000). If the five months June, July,

August, September, and October are taken together, 517.5 out of every 1000 infantile deaths during this period are seen to be due to diarrhoea.

On the other hand pulmonary affections are most virulent during the cold months. As the death-rate from diarrhoea diminishes the mortality from pulmonary affections increases (Fig. 127).

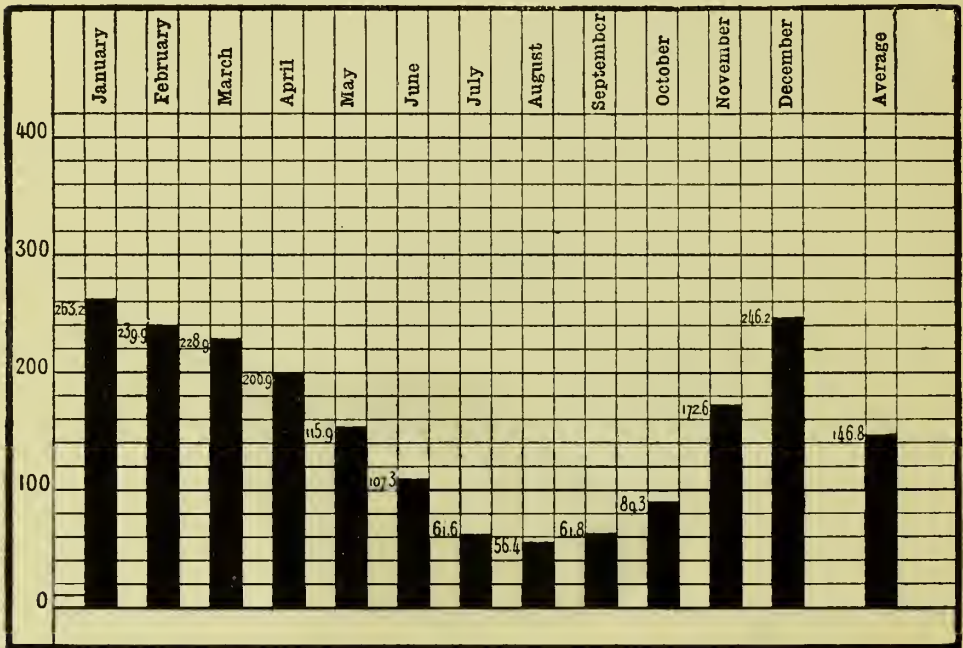


FIG. 127.—Mortality from pulmonary affections during the different months of the year, showing how it increases when the external temperature becomes low.

In January diseases of the chest claim 263.2 out of every 1000 infantile deaths; this proportion falls gradually. It is

239.9 per 1000 in February.	
228.9     "      March.	
200.9     "      April.	
115.9     "      May.	

107.3 per 1000 in June.	
61.6     "      July.	
56.4     "      August.	

Then as the atmospheric temperature falls it begins to increase.

It is 61.8 per 1000 in September.	
" 89.3     "      October.	

It is 172.6 per 1000 in November.	
" 246.2     "      December.	

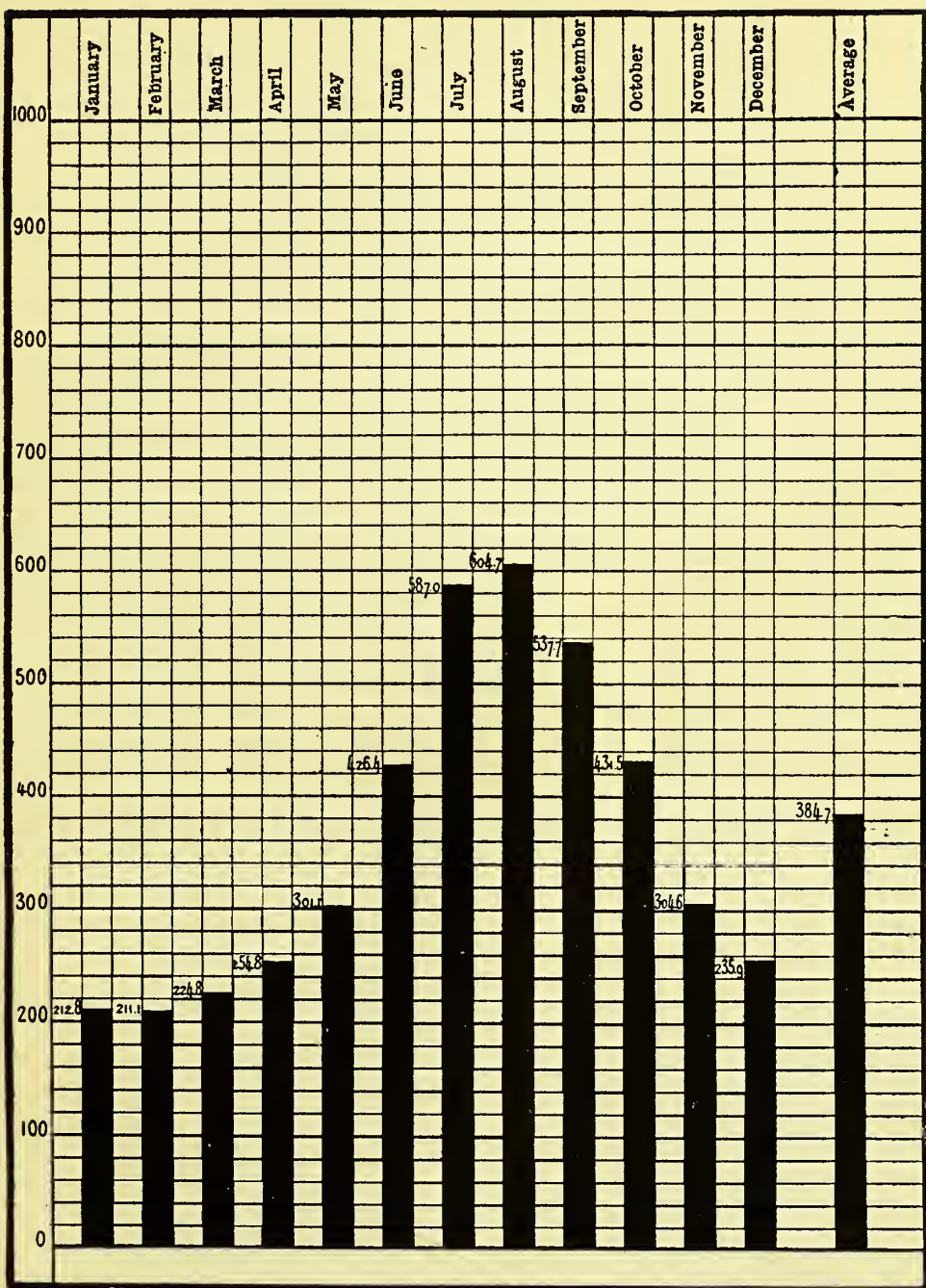


FIG. 128. —Mortality from diarrhoea during the different months of the year, showing the considerable increase during summer.



# APPENDIX XI

## LABOURS ARTIFICIALLY INDUCED BY M. BUDIN IN 1898

Number of Labour.	Parity.	Former Labours.	Diameter of Pelvis, p.s.p.	Date of Delivery.	Mode of Induction.	Duration of Labour.	Termination.	Weight of Infant.		State on Departure.		Date of Departure.
								Birth.	De- parture.	Infant.	Mother.	
642	V {	2 at term 2 before term	9.5	May 11	Krause's Sound	12 h. 30 m.	Spontan.	2290	2410	Good	Good	May 24
738	VI {	3 at term 1 at 8 months	10.6	May 30	Tarnier's Bag	16 h.	Spontan.	3000	3200	Good	Good	June 10
815	V {	1 before term 3 at term	9.4	June 15	Packing	18 h. 15 m.	Spontan.	2800	2780	Good	Good	June 23
984	II	1 at term	9.5	July 14	Krause's Sound	6 h. 45 m.	Spontan.	2110	2100	Good	Good	July 28
1569	II	1 at term, sp.	10.4	Nov. 19	Dilator	11 h. 30 m.	Spontan.	3220	3480	Good	Good	Nov. 29
1570	IV {	1 at term, basiot. 2 inductions infant living	10.4	Nov. 20	{ Krause's Sound Packing }	9 h. 15 m.	Int. version	3480	3220	Good	Good	Nov. 30
1693	X {	7 inductions 6 infants living 1 infant dead 2 abortions	10.0	Dec. 20	{ Packing Dilator }	29 h.	Int. version	3220	3020	Good	Good	Dec. 29



# APPENDIX XII

## TABLE OF THERMOMETRIC EQUIVALENTS

Degrees Centigrade.	Degrees Fahrenheit.	Degrees Centigrade.	Degrees Fahrenheit.	Degrees Centigrade.	Degrees Fahrenheit.
0	= 32.0	18	= 64.4	36	= 96.8
1	= 33.8	19	= 66.2	37	= 98.6
2	= 35.6	20	= 68.0	38	= 100.4
3	= 37.4	21	= 69.8	39	= 102.2
4	= 39.2	22	= 71.6	40	= 104.0
5	= 41.0	23	= 73.4	41	= 105.8
6	= 42.8	24	= 75.2	42	= 107.6
7	= 44.6	25	= 77.0	43	= 109.4
8	= 46.4	26	= 78.8	44	= 111.2
9	= 48.2	27	= 80.6	45	= 113.0
10	= 50.0	28	= 82.4		
11	= 51.8	29	= 84.2		
12	= 53.6	30	= 86.0		
13	= 55.4	31	= 87.8		
14	= 57.2	32	= 89.6	98	= 208.4
15	= 59.0	33	= 91.4	99	= 210.2
16	= 60.8	34	= 93.2	100	= 212.0
17	= 62.6	35	= 95.0	110	= 230.0

## APPROXIMATE EQUIVALENTS OF MEASURES OF WEIGHT

5 2 $\frac{3}{4}$	10 5 $\frac{1}{2}$	15 8 $\frac{1}{2}$ $\frac{1}{2}$	20 11 $\frac{1}{4}$	25 14	30 17 1	40 22 $\frac{1}{2}$	50 28	60 34 2	70 39 $\frac{1}{2}$	80 45	90 50 $\frac{3}{4}$ 3	100 56 $\frac{1}{2}$	grams. drachms. ounces.
125 4	150 5	200 7	225 8	250 9	300 10 $\frac{1}{2}$	350 12	400 14	450 16 1	500 17 $\frac{1}{2}$	550 20 1 $\frac{1}{4}$	grams. ounces. lbs.		
600 21	650 23	700 25 1 $\frac{1}{2}$	750 26	800 28 1 $\frac{3}{4}$	850 30	900 32 2	950 33	1000 35 2 $\frac{1}{2}$	1250 44 2 $\frac{3}{4}$	grams. ounces. lbs.			
1500 3	2000 4 $\frac{1}{2}$ 2	2500 5 $\frac{1}{2}$	3000 6 $\frac{1}{2}$ 3	3500 7 $\frac{3}{4}$	4000 9 4	4500 10	5000 11 5	6000 13 6	kilograms. grams. lbs.				
7 7000 15	8 8000 17	9 9000 20	10 10,000 22	11 11,000 24	12 12,000 26 $\frac{1}{2}$	13 13,000 29	kilos. grams. lbs.						

## APPROXIMATE EQUIVALENTS OF MEASURES OF CAPACITY

15 $\frac{1}{2}$	20 $\frac{3}{4}$	30 1	40 1 $\frac{1}{2}$	50 1 $\frac{3}{4}$	60 2 $\frac{1}{4}$	70 2 $\frac{1}{2}$	100 3 $\frac{1}{2}$	125 4 $\frac{1}{2}$	150 5 $\frac{1}{4}$	175 6	200 7	225 8	250 8 $\frac{3}{4}$	cubic cen- timetres, ounces.
300 10 $\frac{1}{2}$ $\frac{1}{2}$	350 12 $\frac{1}{4}$	400 14	450 15 $\frac{3}{4}$ 2 $\frac{3}{4}$	500 17 $\frac{1}{2}$	550 19 $\frac{1}{4}$	600 21 1	650 22 $\frac{3}{4}$	700 24 $\frac{1}{2}$	750 26 $\frac{1}{4}$	800 28	850 30 1 $\frac{1}{2}$	900 31 $\frac{1}{2}$	950 33	c.c.m. ounces. pints.
			1 1000 35 1 $\frac{3}{4}$	1 $\frac{1}{4}$ 1250 44 2	1 $\frac{1}{2}$ 1500 52 2 $\frac{1}{2}$		1 $\frac{3}{4}$ 1750 61 3	2 2000 70 3 $\frac{1}{2}$		2 $\frac{1}{2}$ 2500 87 4 $\frac{1}{4}$				litres. c.c.m. ounces. pints.

## APPENDIX XIII

### STATISTICS OF THE MORTALITY FROM DIARRHŒA IN ENGLAND

THE following table is compiled from the Registrar-General's weekly returns of births and deaths in the seventy-six largest towns of England and Wales, during July, August, and September 1906 :—

Number of Week.	Total Births.	Total Deaths from 0-1 Year.	Infantile Deaths per 1000 Births.	Deaths from Diarrhœa.
July 27 . . .	8,708	774	88.8	92
28 . . .	8,322	706	84.8	113
29 . . .	8,717	841	96.4	165
30 . . .	8,348	940	112.5	220
Aug. 31 . . .	8,988	1,193	132.7	492
32 . . .	7,361	1,513	205.5	865
33 . . .	8,877	2,125	239.3	1,385
34 . . .	8,784	2,321	264.2	1,651
Sept. 35 . . .	8,663	2,398	276.8	1,765
36 . . .	8,350	3,024	360.9	2,342
37 . . .	8,349	2,850	341.3	2,311
38 . . .	8,356	2,480	296.7	1,768
39 . . .	8,386	1,893	225.7	1,137
Total . . .	110,209	23,058	...	14,306

## APPENDIX XIV

### ANALYSIS OF MILK SUPPLY OF LONDON

To determine the quality of milk consumed in London, Mr. J. Wicliffe Peck, F.C.S., and the translator collected at random 101 samples of that offered for sale in various districts, between September 28 and October 10, 1906. The following are the results of their analysis:—

District.	Number of Samples.	Average Percentage of Butter.	Average Percentage of Butter Removed.	Average Percentage of Water Added.
Battersea . . . .	2	4.50	...	...
Bethnal Green . .	2	3.25	18.75	9.14
City . . . . .	2	4.00	...	4.00
Chelsea . . . . .	6	3.55	11.25	7.05
Deptford . . . .	4	4.20	...	2.90
Finsbury . . . .	2	3.30	17.50	11.45
Fulham . . . . .	4	3.50	12.50	5.06
Hackney . . . . .	2	3.20	20.00	6.41
Hammersmith . .	3	3.68	8.00	5.70
Hampstead . . .	3	3.73	6.75	5.85
Holborn . . . . .	8	3.54	11.50	13.86
Islington . . . .	5	3.96	1.00	8.32
Kensington . . .	5	3.88	3.00	8.05
Lambeth . . . . .	7	3.74	4.00	8.75
Lewisham . . . .	4	3.65	8.75	6.13
Paddington . . .	2	3.40	15.00	2.22
Poplar . . . . .	2	3.75	6.25	7.54
St. Marylebone .	2	3.70	7.5	6.96
St. Pancras . . .	12	3.69	7.75	10.76
Shoreditch . . .	2	3.25	18.75	5.92
Southwark . . .	2	3.70	7.5	6.22
Stepney . . . . .	2	3.95	1.50	10.35
Stoke Newington .	2	4.20	...	8.52
Wandsworth . . .	3	3.00	25.00	6.77
Westminster . .	11	3.82	4.50	7.13
Woolwich . . . .	2	3.27	18.25	14.35
Average . . . . .		3.66	8.5	7.28

68 of the samples of milk had been skimmed: 12 had lost from 1-5 per cent. of the normal butter; 12 from 5-10 per cent.; 16 from 10-15 per cent.; 12 from 15-20 per cent.; 10 from 20-25 per cent.; and 6 more than 25 per cent.; of the last, one had lost 26 per cent., one 29 per cent., two 30 per cent., and one 65 per cent.

89 had been watered: 28 contained 1-5 per cent. of added water; 26, 5-10 per cent.; 17, 10-15 per cent.; 13, 15-20 per cent.; and 5 over 20 per cent.

I cost 3 pence per quart.  
 I cost 3½       "       "  
 99 cost 4       "       "  
 190

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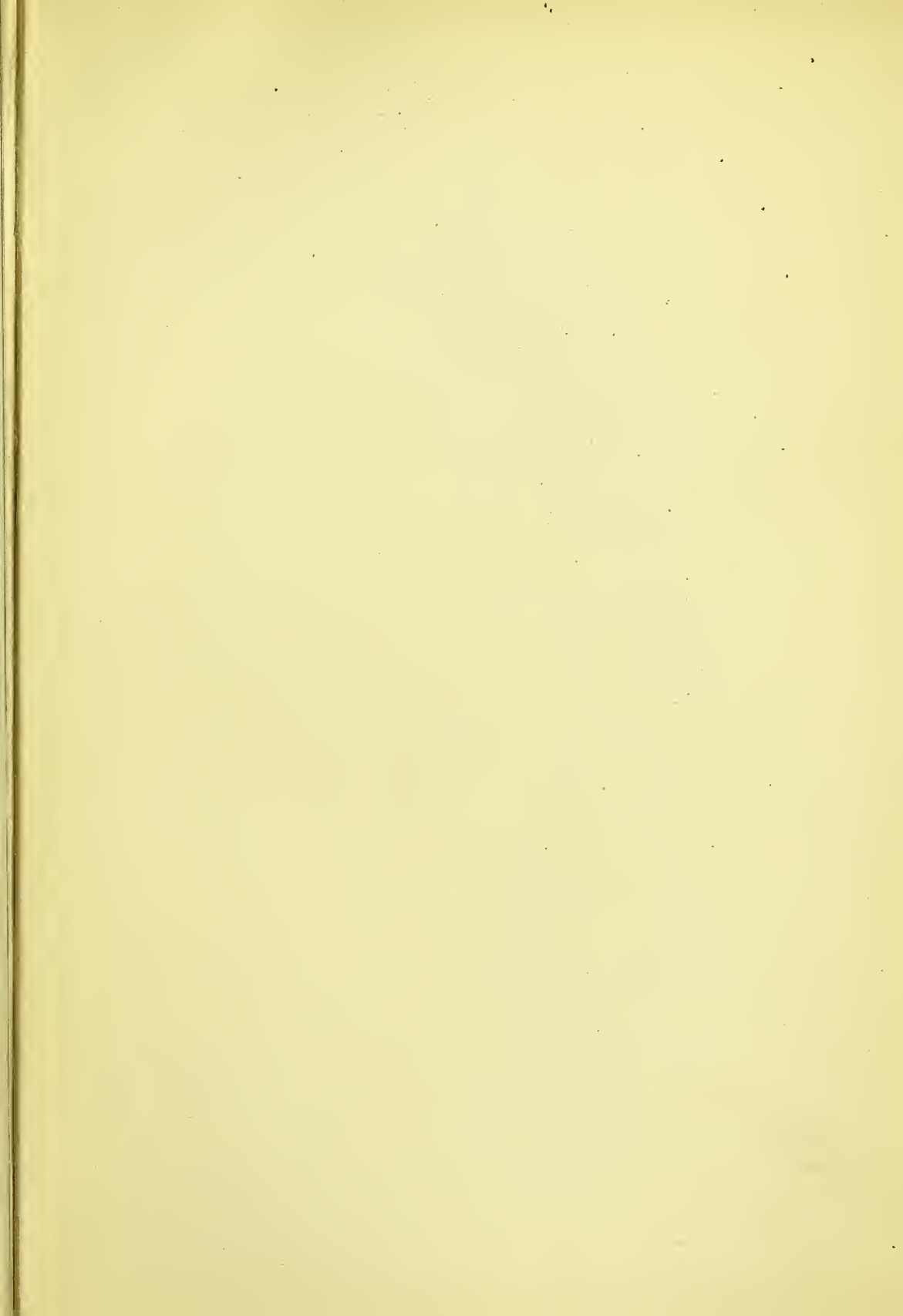
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